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LUCERNE—THE QUEEN OF FODDER CROPS.*

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It is fitting that "Lucerne," or "Alfalfa," because of its particular suitability for the nourishment of young stock of all kinds, should be associated in the minds of farmers with maternal qualities, and in consequence called the "Queen" of fodder plants, just as Maize, with its sterner characteristics and greater suitability as a food for adult animals, is called the "King" of fodder plants. As food, each is complementary to the other, and their alliance when brought about on the farm is followed by the happiest results.

Lucerne was introduced into Greece during the Persian Wars, about 490 B.C., so that it is known to have been cultivated for well over 2,000 years. It has therefore been well tested. It was taken to Spain by the Moors under the name of Alfalfa. The Spaniards introduced it to Mexico, and from that country it spread over South America and extended to the United States and Canada. In Canada and America lucerne is known and cultivated as "Alfalfa." This word is believed to be of Arabic origin, and derived from words which mean "the best fodder." It will thus be seen that its great value for fodder purposes has been long recognised, and the splendid reputation which this plant so early earned, and which by its name has come to us down through the centuries, it still maintains.

It has been thought that the name Lucerne, by which it has been known in England and France, was derived from the Swiss canton of the same name, but Coburn in the "Book of Alfalfa" considers this to be a mistake, as it was not known there until long after it was cultivated in France and England. He states that:—"The name Lucerne is probably derived from the Spanish word 'Userdas,' which the French changed to 'La cuzerdo,' and later to 'Luzerne,' still later to 'Lizerne,' and then to 'Lucerne.'"

The botanical name of Lucerne is *Medicago sativa*. It belongs to the family of leguminous plants, of which it is probably the best known and most valuable member. It usually grows from 1 to 2½ feet high, but occasionally taller. It is a deep-rooting, remarkably long-lived and prolific perennial. Under the best conditions it may be cut many times a year, and year after year. It is stated that there are lucerne fields in Mexico over two hundred years old, and others in France which are known to have been productive for over a century. There

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is no reason to believe that it will not be equally long-lived under Australian conditions if established on suitable soil, suitably manured, and given reasonable attention. The intensive lucerne plot referred to in the issue of the "Agricultural Journal" for April, 1924, when last seen by the writer in 1930 was thirteen years old and still flourishing. There was then no sign of exhaustion.

The deep roots of the lucerne plant penetrate readily to 10 to 20 feet, and have been traced to much greater depths. Coburn records a case where the roots were found penetrating through crevices in the roof of a tunnel one hundred and twenty-nine feet below the surface of a lucerne field.

Climate.

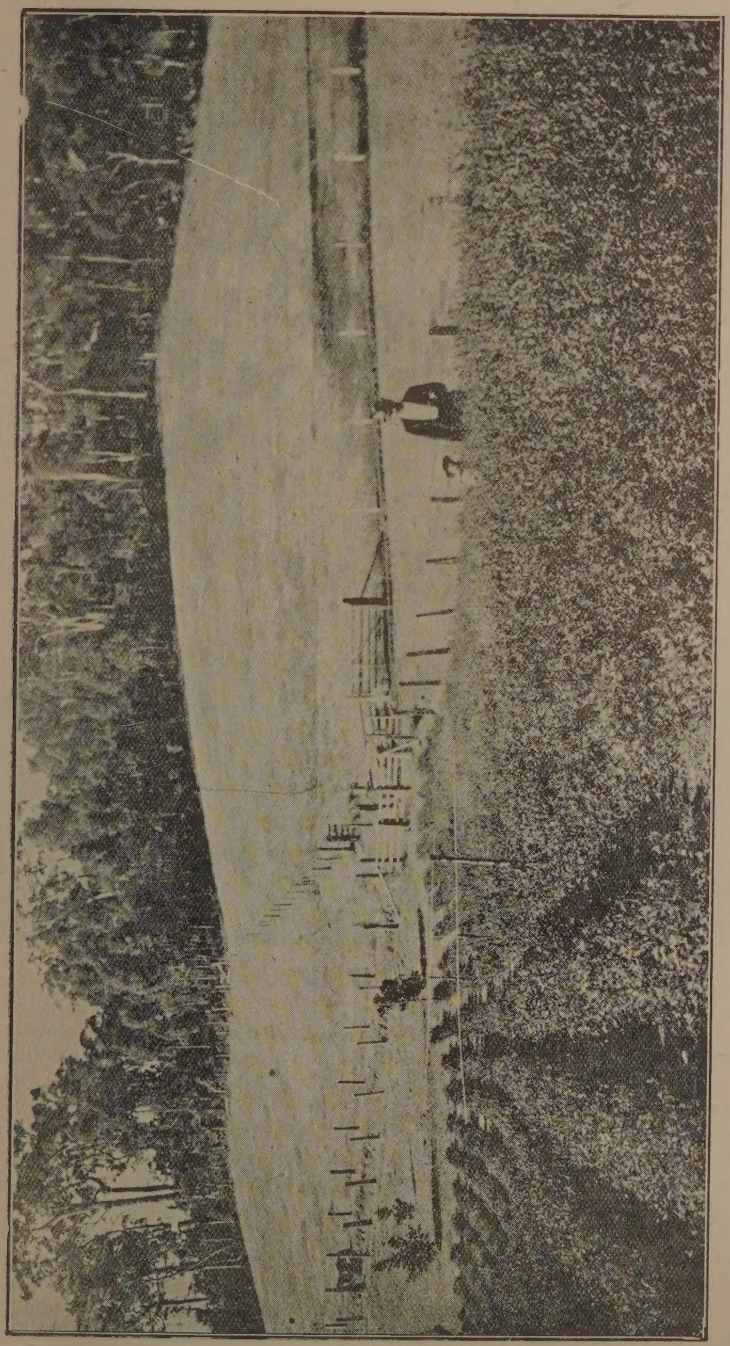
Lucerne loves heat, and makes its maximum growth in spring and summer. It is at its best when plentiful supplies of water are found in combination with heat. Under such conditions, which usually involve irrigation, it is remarkably prolific, successive cuttings of luxuriant forage being obtained at intervals of five to six weeks, with an aggregate yield per acre of 20 to 25 tons of green fodder, or, if made into hay, of six to eight tons. Owing to its deep-rooting system it is well able also to withstand extremes of temperature. The writer when in New South Wales has found it growing as far north as the Queensland border, and south not far from Kosciusko. It is also well adapted to withstand summer drought. Grown experimentally without irrigation at Chapman and Merredin Research Stations, it has proved that it will live for several seasons through dry summers, remaining dormant during the dry weather, awaiting the summer showers or the winter rains to spring to activity.

It is believed that there is no part of the agricultural area in which this plant cannot be made to serve some useful purpose. For maximum returns for fodder or hay, irrigation will probably be necessary in most districts, but even in the drier areas sufficient information is available to indicate that it is likely to prove useful for grazing. It is anticipated, however, that its greatest usefulness will be in the Dairy Belt, and because of its great fodder value no dairyman should be without his lucerne patch.

Soil.

Lucerne is not particular as to soil. With suitable treatment it will grow on almost all classes of soil, from nearly pure clay to light sandy soil. At one time it was thought that it would only grow on rich, deep alluvial soil, but experience has shown that there is hardly any kind of soil on which it will not grow provided the soil is not waterlogged or sour. The most favourable soil is a rich, somewhat sandy loam, warm and friable. The highest yields are obtained with the least trouble on the very best alluvial soils found on creek and river banks well supplied with plant food and with free water from 6 to 20 feet below the surface. At one time the heavy clays were considered unsuitable, but cases are recorded where excellent crops have been raised on soils of this character, but more care is required in preparing the seed bed than on the friable loams. Whilst lucerne can utilise enormous quantities of water during the growing period, it is killed by stagnant water lying upon it. A case is known, however, where the flood waters from the Hawkesbury River remained on the lucerne paddocks for eight days during the winter, when the roots were partially dormant, and without doing it any permanent injury. In this instance the deposit left round the plants was removed as soon as the waters receded.

"Lucerne will not stand wet feet" aptly conveys the meaning of the rule that if the soil is not naturally drained to a depth of several feet, action must be taken to bring about this condition before the lucerne is planted.



An intensive Lucerne plot (in Drills)—"Lawnbrook," Bickley.

Preparation of Seed Bed.

Lucerne likes a compact seed bed with just a little loose soil on top, and as the lucerne seed is small the soil should be well prepared. Though the lucerne plant when established is one of the hardiest of plants, yet when young it is delicate and requires favourable conditions for its support. The seed bed therefore should be warm, mellow and compact, with just a thin layer of loose soil on top. It is essential that the seed bed proper be compact, in order that the seed may germinate readily and the soil moisture move most freely in all directions to convey the necessary nourishment to the young plantlet. The compact soil in which the seed is deposited should be covered, however, with a layer of loose soil, thin enough for the small and tender plant to force its way through, so that the evaporation of the moisture brought near the surface by the compaction of the underlayers for the use of the roots will be lessened. Because of these requirements it is generally advisable to commence the preparation of the land some time before sowing, usually by fallowing, and the ploughing can then be deep. Except in rare instances the ploughing should not be done later than at least six weeks before the seed is to be sown, for if ploughed later than this it is difficult to get the seed bed into that compact condition

Experimental Lucerne Plot—Merredin, 1919.

which is so essential for the best results with the establishment of this crop. The planting of the seed on a loose seed bed is a frequent source of failure with the lucerne crop. It is also advisable that the seed bed be as free from weeds and weed seeds as it is possible to get it, for the delicate young lucerne plant cannot compete with the hardy young weeds of a dirty seed bed, though when established the reverse is the case, for it is the hardiest of plants, and but few weeds can compete with it. In its early stages weeds are very formidable and serious handicaps, and it is believed that more failures are due to the presence of weeds amongst the young lucerne plants than to any other cause.

An experiment to ascertain the effect in this connection was carried out at the Merredin Research Station in 1919. This experiment was planted on forest land. The plots were one-fortieth of an acre in area—25 links wide and one chain long. The seed bed was well prepared by fallowing; on one spot the

weeds were destroyed, on the other they were allowed to grow. The rainfall subsequent to the planting was good, and to the end of the year was as follows:—April, 302 points; May, 17 points; June, 105 points; July, 233 points; August, 164 points; September, 43 points; October, 186 points; November, 38 points; December, 9 points. The seed germinated well on both plots.

On the hand-weeded plots, the lucerne plants grew well. On 9th October the average height of the lucerne plants was 18 inches, and about one-fifth of them were in flower. It was then cut with a scythe and weighed; the green material was allowed to remain on the plots until cured as hay, when it was again weighed. The computed yields per acre in each case were:—Green weight, 61 cwt.; hay weight, 29 cwt. 3 qrs.

On the unweeded plots the weeds, mainly barley grass, grew apace and so thickly that only a few plants of lucerne were visible. This weed growth was cut off at the same time as the lucerne on the other plots, after which the vegetation remained dormant until the rains in March. Some plants were then noticeable on these plots, but they were neither as numerous nor as vigorous as those on the plots which had been weeded.

The difference in the results obtained from the weeded and unweeded plots brings out in a marked manner the necessity of freeing young lucerne plants from the more vigorous weeds. As it is not a commercial proposition to control the weeds on a large area by hand-weeding, it is clearly essential to obtain a seed bed as free from weeds as is possible by destroying them before the lucerne is planted. The importance of securing a seed bed free from weeds is so thoroughly recognised by one of the most successful growers of lucerne in the wheat belt of New South Wales that it was his practice to commence to prepare for lucerne three years before it was sown. This does not mean that the land was uncropped for that period, but that the cropping adopted was such as would tend to destroy weed growth. As the crop is a perennial one, the thorough preparation of the seed bed necessary to make it compact and free from weeds is justified.

Season to Plant.

In warm and particularly the dry districts of Western Australia autumn sowing, i.e., in March and April, is likely to give best results, provided weeds can be controlled. Rain usually falls then and the ground is warm to ensure a good germination of the seed and a vigorous growth of the plants. During the winter plants have opportunities to make a good root growth, so that the plants become strong enough to stand the hot weather of summer. On the other hand, in cool districts with a liberal rainfall or where weed growth is troublesome, spring sowing may be advisable. When spring sowing is practised the ground should be fallowed in autumn or winter, so that the cultivation in winter and spring will afford opportunities for destroying weeds. This is the plan so successfully adopted in the southern districts of Wagin, Katanning and Gnowangerup, where considerable areas are planted for pasturing sheep.

Dodder.

Dodder (Cuscuta spp) is a parasitic plant vine which grows from seed. It is probably the most serious lucerne pest the grower has to face. The seed germinates in the soil and retains its connection with this until it comes into contact with the stem of the lucerne plant. It then severs its direct connection with the soil and lives upon the juices of its host, the lucerne plant, until it ripens its seed or has killed the host. Once started dodder continues to grow and spread by means of its tendrils, which grow from one plant and catch other adjacent ones. The plants first attacked begin to die and the pest spreads out in all directions.

The tiny seed of this pest is sometimes found in an admixture of lucerne seed, and because of this disastrous effect upon the crop precautions should be taken to prevent its being introduced with the lucerne seed which is being sown. Because of the difference in their relatives sizes, some dodder seed can be separated from lucerne seed by suitable cleaning machinery, but, because of the vital importance of not introducing dodder, only lucerne seed which has been harvested from crops known to be free from dodder should be used.

Lucerne and Dodder.

It may be, however, that despite the precautions taken, dodder has established itself. Every effort should be made to eradicate it. If very generally established, probably the best way of dealing with this pest will be to plough up the paddock and grow other crops upon it for a number of years until all the dodder seeds have germinated and the plants arising therefrom have been killed. For dealing with isolated patches the usual method recommended is to mow or hoe them, cover them with straw, and burn the dried material. Close and repeated grazing for some time may also prove effective, as the animals are likely to eat the dodder quite close to the ground and prevent it forming seed. Mowing has proved ineffective owing to the fact that little tendrils of the dodder plant are left on the lucerne stems near the ground and below the cut surface of the lucerne.

Varieties.

There are several kinds of Lucerne. These are, however, types rather than varieties, and are mainly of localised character and usually distinguished by the name of the country in which they have been grown, e.g., Peruvian, Turkestan, Arabian, African, etc. Many of these have been tried in Australia, including trials at the Chapman Research Station, W.A. The results obtained there are in accord with those obtained in the Eastern States, and are to the effect that none is as suitable for, or as prolific under Australian conditions, as the Australian type, which has been evolved as the result of the survival of the fittest. This early experience has been confirmed by experiments carried out by Mr. Dunne, the Mer-

chants' Research Officer, Muresk Agricultural College. In the June issue of this Journal, 1935, he reported.

"In 1932, a number of varieties of lucerne were collected and planted with a view to making preliminary comparisons of drought resistance and growth. The following varieties of *Medicago sativa* were included, viz., Hunter River, Marlborough, Tamworth, Mudgee, Tagerim, South African, Provence, Italian, English, Chinese, Mongolian, Poitu, Spanish, Smooth Peruvian, Hairy Peruvian, Montana, Dakota, Kansas, Ladak, Utah, Hardigan, Arizona Common, California Common, North Californian and Grimm. Hardy lucerne, a variety of *Medicago media*, was also included.

"The experiment was carried out on a sandy loam soil which had been timbered with jam. The average rainfall at Muresk is 17 to 18 inches per annum, most of which falls during the winter season. The first reliable cropping rains usually occur about the beginning of May and the last useful rains during October. Occasional good falls are sometimes recorded earlier in the autumn.

"No supply of moisture was available for summer growth. The plants were not irrigated, and there was no subsoil seepage.

"It will be appreciated that, under these conditions, the most desirable varieties would be those which, in addition to being able to survive the dry summer months, were capable of making a reasonable amount of growth during the cooler months of the year. Varieties able to grow only under warm conditions would be unsatisfactory owing to the fact that during most of the warm weather no moisture would be available.

"Early rains were received in 1932 and planting was possible on 7th April. The rows were about half a chain in length and were spaced about 18 inches apart. Good germination was secured and all varieties made a satisfactory beginning. Superphosphate was applied at the time of seeding and thereafter each autumn and spring.

"It was found possible to cut the varieties three times each year, about the end of June and of September and during November. In a good season four cuts could be secured. Cutting was done when the most forward varieties contained a fair proportion of the plants in flower. At this stage the best varieties were 2ft. 6in. to 3ft. in height. The late September cutting was usually the best. The growth of the better varieties was considered very satisfactory for the conditions.

"The best two varieties as shown by the trial were North Californian and Hunter River. The former made a somewhat quicker recovery after cutting and made a little better growth during the colder months. However, the stems of this variety, which tended to become quite hard about the time of the November cutting, appeared to be normally rather coarse. This undesirable feature may possibly have been overcome by a heavier seeding. Hunter River made quite satisfactory growth throughout the season and had thinner stems and more leaf than North Californian.

"Hairy Peruvian, which made satisfactory growth, appeared to be the next best variety. In stem and leaf it was about intermediate between Hunter River and North Californian.

"There was little difference in value observed between a number of varieties comprising Marlborough, Mudgee, Tamworth, South African, Smooth Peruvian, and California Common. All appeared to be inferior to those above mentioned.

"Practically no winter growth was made by varieties which have been selected for varying degrees of winter hardiness and ability to withstand extremely cold conditions. Any growth made was practically confined to October and November. These included the American varieties, Grimm, Ladak, Utah, Hardigan, Kansas, and Hardy, as well as Tagerim, Chinese, and Mongolian.

"All varieties under test were quite drought resistant and were able to keep alive over the dry summer.

"The preliminary trials indicate that, under conditions similar to those obtaining at Muresk, it is best to continue with Hunter River lucerne, which has already given satisfaction under a variety of conditions in Australia. More extensive trials may show additional merit in North Californian or Hairy Peruvian for these conditions, but until these are carried out no departure from the Hunter River variety can be recommended.

"Owing to the presence of other trials in the same area it was only possible to graze with sheep on one occasion (June, 1934). It is possible that the results may have been somewhat modified were the plants grazed instead of cut, but it is believed that in the main the conclusions would be similar."

During recent years advertisements have appeared in the agricultural press claiming very distinct advantages of certain strains of lucerne, the roots of which are offered for sale. These roots are said to be the progeny of a selected surface rooting plant, and it is claimed that planting them will result in the establishment of a superior type of lucerne. As the result of very careful inquiries growers cannot be advised to purchase these roots, as there is no evidence to show that they have any advantage over the best strains of the Australian variety. In this connection the following warning was issued by Mr. H. Wenholz, Director of Plant Breeding, New South Wales Department of Agriculture:—

"Any lucerne grower knows how variable in composition his lucerne field is, consisting as it does of plants which vary considerably in habit, growth, leafiness and response to climatic conditions. The Department has had some of the well advertised lucernes under observation, and has not seen in any of them anything superior to what exists in isolated plants in any lucerne field. Growers are advised to accept with much caution the optimistic announcements being made with regard to new lucernes, especially to those the distribution of which is being effected by roots."

Good seed of the right kind is essential, and therefore the grower should see that he obtains it by using Australian-grown seed, most of which now comes from New South Wales. Realising the superiority of seed produced in the Commonwealth, the Federal Government now insists that all imported seed shall be stained pink, so as to make it readily distinguishable from the local seed, which in colour ranges from green to purple. Most of the seed produced in the Commonwealth is grown in New South Wales in the Hunter River, Tamworth and Mudgee districts. Seedsmen are required to guarantee the germination and the maximum percentage of weed seeds and impurities in the samples offered. A good sample should have a germination of about 80 per cent., and should not contain by weight more than 1 per cent. of weed seeds and of impurities. The sale of lucerne containing dodder and other noxious weed seeds is absolutely prohibited.

Rate of Seeding.

The amount of seed depends upon the purpose for which the crop is intended. For hay-making purposes the amount sown by farmers ranges from 6 to 25 lbs. per acre. If, however, it is intended that the crop shall be grazed, the quantity

sown is much less and ranges from 2 to 8 lbs. per acre. In some of the lucerne growing districts of the Eastern States where lucerne hay is the staple crop the practice is to sow about 25 lbs. of seed per acre, and growers have been known to state that they would prefer to sow 30 rather than 20 lbs. per acre. This attitude is due to a realisation of the fact that many causes operate against plants succeeding and prevent more than a small percentage of the seed from producing healthy established plants; the young seedlings are tender and have difficulty in reaching the surface after germination. During the process of covering many of the seeds sink too deeply into the soil, whilst many remain quite near or on the surface and fail owing to insufficiency of moisture. Further, whilst the lucerne crop is being established a process of elimination occurs, weeds rob the soil of the fertility, use up moisture, and compete with the lucerne for light. This makes the plants thin and spindly and generally saps their vigour, and in consequence it is only the strongest plants which survive.

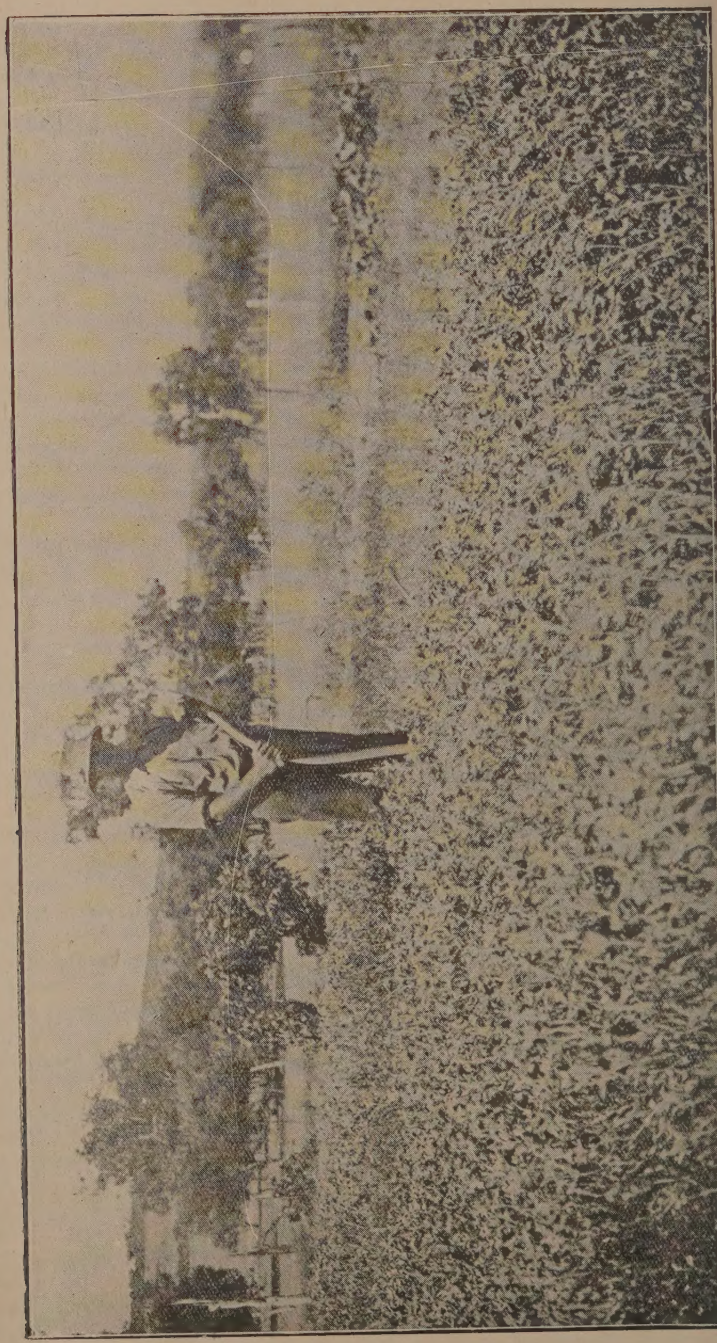
It is considered that, when established, a stand of some 500,000 plants per acre is ample. Seeing that 1 lb. of lucerne seed contains about 220,000 seeds the use of from 2 to 3 lbs. of good seed per acre would meet these requirements, and though it is recognised that a farmer should not run the risk of a thin crop as the result of being niggardly with the seed, it is considered that the use of 6 lbs. of good seed on well prepared land allows for the many contingencies referred to, and that to use more than 12 lbs. is unduly extravagant.

Generally speaking, if the seed is to be sown in drills, 6 to 8 lbs. per acre will be found satisfactory, but if broadcast, 8 to 12 lbs. per acre may be expected to give a good result.

Method of Sowing.

Except on loose, drifting sands lucerne need not be sown with a nurse crop. There is a general agreement amongst experienced lucerne growers that if lucerne succeeds with a nurse crop it is in spite of the additional drain upon the soil moisture instead of by reason of it. This is particularly applicable to dry climates, for when there is only a limited supply of moisture available, all this will be required to germinate the seed and give the young plant a vigorous start in life.

The seed is usually broadcasted and should be sown near the surface. The seed may be broadcasted either by hand, by a hand broadcasting machine of the "Cahoon" or similar type, or through the grass seeding attachment of the ordinary grain and fertiliser drill. An even distribution of seed is desirable; it is not easy to obtain this by broadcasting with such small quantities of small seed. When necessary to sow by hand it is convenient to follow behind a roller or harrow, so as to have a clearly defined area on which to sow. The small quantity of seed used is dealt with by using the finger and thumb instead of the whole hand for picking up and spreading the seed; and sometimes to facilitate the work and ensure more even distribution the seed is mixed with dry soil or ashes. When the hand machine is used a small quantity of seed can be sown best by turning the handle the opposite way to the usual one. The seed can be sown down the seed box of the grain and fertiliser drill if mixed with some bulky material like bran. It is sometimes mixed with superphosphate and sown through the fertiliser box, but this method is not recommended on account of the destructive action of the fertiliser on the vitality of the seed. When sowing the seed through the "shoes" of the drill grain there is some risk that the seed may be planted too deeply, but provided this risk is known it can be guarded against and avoided. When sown down the tubes of the grain drill the seed can be deposited on the surface by removing the tubes from the "shoes," and at the same time a broadcasting effect can be obtained by arranging for the seed to be dropped on to a sloping board fixed with an inclination of about 30 degrees to the ground.



Lucerne at Nabawa. Grown by Mr. S. E. Gould.

The seed is sometimes sown in drills which are far enough apart to admit of intertillage. This method is believed to be the best for dry districts, and particularly for places where weeds are troublesome, and for small patches. It is further recommended as the method to be adopted when determining the suitability of new locations for this crop. The results obtained by Mr. A. C. R. Loaring at "Lawnbrook," Bickley, with lucerne in drills 2ft. 9in. apart, and recorded in the "Agricultural Journal," April, 1924, prove that there is no need to fear lessened yields from the adoption of this method, and it has several distinct advantages. It enables the land between the rows to be kept loose by cultivation, as the result of which loss of soil moisture by evaporation is reduced to a minimum, and the water is conserved for the use of the crop. Another advantage is that the cultivation given to conserve the moisture also destroys weeds, thus preventing the crop from being robbed of the plant food and moisture which the weeds would use for their growth. It has the further advantage that a saving of seed is effected when planting in this way, for, assuming that only 50 per cent. of the plants were obtained from the seed planted, 2 lbs. of seed will provide 15 plants per foot of row if the rows are 3ft. apart. The seed is covered either by rolling or by harrowing with a light or brush harrow, but it is best covered by the joint operations of both rolling and harrowing. The rolling presses the seed into the soil, and in this way the germination is assisted; it is, however, undesirable to leave the surface compacted and smooth as left by the roller, for this tends to draw the moisture to the surface where it can be evaporated, and in addition a rolled surface crusts readily after a shower. These disadvantages can be overcome by lightly harrowing the rolled surface.

Inoculation.

Under certain conditions lucerne, in common with other Legumes, is able to obtain the nitrogen for its requirements from the free nitrogen of the air, which contains about 80 per cent. It is enabled to do this by the aid of certain vegetable organisms or bacteria which derive their sustenance from the nitrogen of the air and the starch of the plant. When acting in this way the presence of these bacteria can be noticed by the appearance of wartlike nodules or tubercules on the roots. The nodular swellings are filled with the micro-organisms and are usually in clusters. Some are as small as a pin's head, others as large as a pea. It was thought at one time that each legume—lucerne, trefoil—had a distinct organism, but now it is believed that legumes of closely related kinds have the same organism and will pass from one kind to another. Thus the bacterium found on "White Sweet Clover" and on "Burr Medic" or "Burr Trefoil" have proved to be also suitable for lucerne, and similarly the one found on the Pea suitable for the Broad Bean or Vetch.

These nitrogen collecting bacteria do not act when there is an abundance of nitrogen in the soil available for the use of the legumes. So to speak, they become lazy.

Seeing that in soils deficient in nitrogen lucerne will be dependent upon the presence of nitrogen-gathering bacteria for its supplies of nitrogen, it follows that if they are not present its development will suffer and will be shown by the pale colour of the foliage. It is important, therefore, to have these organisms in the soil; in fact, lucerne cannot be a complete success without them. Because of the manner in which trefoils flourish throughout this State there is every reason to believe that they will be present naturally throughout the agricultural areas wherever trefoils are found. If, however, they should prove to be absent, they can be introduced, and this process is called inoculation. In the past the most generally adopted method of carrying out the inoculation has been to distribute

over the new land intended for lucerne a small quantity of the surface soil from an old established lucerne patch. Soil containing or infected with the required bacteria, at the rate of about 100 to 200 lbs. per acre, is harrowed in with the seed or just before sowing. The danger attendant upon this method is the risk of introducing weed seeds, fungus diseases, or eelworms.

It was found that these nitrogen-fixing bacteria belonging to the different groups of legumes can be isolated and prepared for distribution in convenient form as "cultures." This scientific discovery was developed to such an extent that "cultures" for the different legumes were used with great success by mixing them with seed before sowing. Recently reports from England indicate that good results have followed the application of these "cultures" to old lucerne fields. In Western Australia excellent results have been, and are being, obtained from the use of "cultures" applied to new land at the time of sowing.

"Cultures" for lucerne and other legumes are now prepared in the laboratory of the Pathological Branch of the Department, and can be obtained by farmers on payment of a small charge.

The effect of lime is to encourage the growth of these bacteria. If the crop is not suffering from excess water, and there are evidences—such as the pale colour of the leaves, or the absence of the nodules on the roots—that the necessary bacteria are not functioning, mild lime at the rate of about one ton to the acre should be applied. On sour and sandy soils a similar dressing of mild lime is also recommended to be supplied at least one month before the seed is sown. In addition to stimulating the bacterial activity already referred to, it will also have the effect of correcting the acidity which is so detrimental to success with lucerne.

Manuring.

Lucerne is a heavy feeder. Under suitable conditions twenty tons of green crop may reasonably be expected in a season, and this would contain about 340lbs. of nitrogen, 60lbs. phosphoric acid, and 250lbs. of potash. Fortunately, except during the period immediately following germination, this plant is not usually dependent upon the soil for its nitrogen supply. Being a legume it can, when suitable bacteria are present, obtain all its requirements in this connection from the inexhaustible supply contained in the air. But the phosphoric acid and potash must be obtained from that already in the soil or from fertilisers applied to the soil. On fertile loams it may be assumed that the soil will contain sufficient nitrogen to meet the requirements of the young lucerne plant, and supply its needs until the necessary bacteria are sufficiently plentiful to enable it so secure all its needs in this connection from the air. Because the young plant requires to obtain its early nitrogen requirements from the soil, a small application of nitrogenous manure—sulphate of ammonia, blood, or nitrate of soda—is, however, recommended for sandy soils or others deficient in nitrogen-forming material. Guided by experience in the Eastern States, it is unlikely that, except in sandy soils, potash manuring will be necessary in the early stages, but it is equally likely that manuring with phosphoric acid will be followed by marked beneficial results. An application of from 2 to 3 cwt. of superphosphate per acre is recommended on all soils, even the best.

On loams poor in organic matter it will be advisable to supplement the superphosphate with an application of sulphate of ammonia up to 100lbs. per acre, so as to meet the requirements of the plant for nitrogen until it is sufficiently established to obtain what it needs from the air. On such soils the fertiliser recommended is therefore:—superphosphate, 3cwt. per acre; sulphate of ammonia, 1cwt. per acre. The fertiliser recommended per acre for sandy soils or those

deficient in plant food is a complete one consisting of, say:—sulphate of ammonia, 100lbs.; superphosphate, 400lbs.; muriate or sulphate of potash, 400 lbs.

Except in soils unusually rich it will be necessary to fertilise the crop annually. Subsequent applications of fertilisers should be governed largely by the returns aimed at or secured. If the soil is not rich enough for its latent fertility to be drawn upon, or if it is desired to replace the plant food removed by the crop, then an application of superphosphate 14 lbs., sulphate or muriate of potash 25lbs., is recommended for every ton of green lucerne removed.

Lucerne at Wagin. Grown by Mr. G. A. W. Piesse.

Well saved stable manure is very suitable for this crop, for in addition to the plant food it contains it also supplies organic matter to the soil, and this improves its mechanical condition. If kept on the surface it acts as a mulch to conserve the moisture, and will be of considerable assistance in preventing the formation of a crust on its surface. The great drawback is the weed seeds it contains for these, unless killed as the result of rotting, are likely to destroy the young lucerne plants. This objection is therefore lessened when the manure has been well rotted and is not serious when applied to well established lucerne beds.

On sour and sandy soils a dressing of air slaked lime or ground limestone at the rate of 20 cwt. per acre is recommended as a preliminary dressing to be applied at least one month before the seed is sown. This will have the effect of correcting acidity and stimulating bacterial activity.

Treatment after Sowing.

Even in the best prepared soil, weeds are likely to spring up, for most soils, and particularly old and fertile ones, contain dormant weed seeds, and these germinate with the lucerne seeds and become a menace to its success. It is not possible to cultivate the ground to destroy the weeds which may grow amongst the recently-planted lucerne, for in its young state it is so delicate and with so little roothold that even a harrowing is likely to pull out or damage a considerable number of plants. Lucerne planted in the autumn will rarely be strong enough to be cultivated before the following spring, or that sown in spring before the following autumn. Short of hand-pulling, which is only possible on small areas, the most practical method of controlling weeds in young lucerne is to mow or graze them. If this latter plan is followed the grazing should be done with small stock and as quickly as possible. The mowing can be commenced when the lucerne plants are four to five inches high, and repeated after a short interval, say, a month. This mowing, though detrimental to weed growth, will not injure the lucerne, but rather will stimulate it. Usually the material from the first mowing will not be worth gathering, and it can therefore be left, with advantage, to mulch the ground. As the object of this mowing is to detroy the weeds it should be undertaken whenever they are plentiful enough to warrant it, irrespective of the condition of the lucerne plants and the necessity for utilising the crop. It is emphasised that mowing does **not** injure but **stimulates** lucerne. When the young plants have a firm roothold, and this can be determined by pulling at them, cultivation of the soil can take place with advantage. Its effect will be to stimulate the crop by letting air into the soil for the benefit of the nitrogen-fixing bacteria, and by conserving the soil moisture. For the first cultivation a light harrow is probably the best implement to use, but as the lucerne gets older much stronger implements, such as the springtooth cultivator or disc harrow can be used. One of the best implements for the purpose on established lucerne—over two years old—is the disc harrow. To one not accustomed to its use it may be thought that it will destroy the lucerne as well as cultivate the soil. This, however, is not so. The discs should not be given too much angle, and they will then split the lucerne crowns and cause them to throw up additional stems.

When the soil of an established lucerne bed becomes hard it can be disced and cross-disced to loosen it up with most beneficial results. There need be no fear that surface cultivation will kill the plants, as they are too deeply rooted to be injured, and the splitting of the crowns is beneficial. Discing and cross-discing is extremely useful should the paddock unfortunately become infested with couch grass. On one occasion the writer had reason to deal with such a paddock, and so badly infested was it that the treatment decided upon was desperate and almost in the nature of a forlorn hope. The ten-acre paddock was double disced twice both ways. The result was astonishing. The lucerne grew with such astonishing vigour as to keep the couch under control when aided by the usual periodical cultivations with the disc, and because of the success which followed this drastic treatment, and which proved that couch grass and weeds could be controlled in established lucerne patches, additional acres of lucerne were planted on that farm.

Feeding Lucerne to Stock.

Lucerne as a food is particularly valuable for the protein it contains. Henry gives the average digestible nutrient in freshly cut lucerne and green fodder maize as:—

	Digestible nutrients per 100lbs.		
	Protein.	Carbo-hydrates.	Fat.
Green fodder maize ..	1.0	11.6	0.4
Green lucerne	3.9	12.7	0.5

From this it will be seen that green lucerne contains nearly four times as much protein as green maize.

The nutrient protein is the most expensive of our food constituents and is essential for the production of lean meat, wool, milk, and eggs. Young animals, cows in milk, and laying hens require much protein, and because of the large amount of protein which it contains lucerne is very suitable for these animals. It can in many instances profitably take the place of bran or oilcake in the ration, particularly of milking cows, and which farmers may have to purchase in order to utilise profitably and economically the other products of the farm, or to maintain a continuous milking period.

Comparative analyses of bran and lucerne hay, as given by Henry, are as hereunder:—

	Digestible nutrients per 100lbs.		
	Protein.	Carbo-hydrates.	Fat.
Lucerne hay	11.0 ..	39.6 ..	1.2
Wheat bran	12.2 ..	39.2 ..	2.7

From the above the similarity between the two is obvious, and it is estimated that in practice 11 lbs. of good lucerne hay is equal to 10 lbs. of bran. In one respect lucerne has a very decided advantage over bran, and that is as a food for pigs. Lucerne is one of the best foods and bran one of the worst for these animals. In the United States of America large numbers of pigs are regularly pastured upon lucerne, and in this connection it is estimated that a vigorous patch of lucerne will carry 15 to 25 pigs per acre, and the pigs will make a gain of about 100 lbs. during the season. Whilst grazing lucerne with pigs it is best to supplement it with an allowance of grain, like maize or wheat. For fattening purposes lucerne will not be found economical if fed alone, for when fed alone all its protein cannot be digested and though the animals increase in weight such increase is principally of bone, blood, and muscle. For fattening animals lucerne requires to be supplemented with foods like maize, wheat, and oats, and other foods richer than lucerne in carbo-hydrates and fat.

Haymaking.

The object of transforming the green material into hay is to get rid of excessive moisture so that the hay when stacked will not heat too much or become mouldy.

Lucerne is much more difficult to make into hay than the cereals. This is because of the very sappy character of the stems, which do not dry as readily as the leaves. These latter are the most nutritious part of the plant, and if they become very dry are likely to fall off the stem during the operations of haymaking. The great object to be achieved therefore is to regulate the drying as far as possible so that the leaves and stems dry simultaneously. The principle underlying the procedure necessary for this is founded upon the fact that the leaves until they are so dry that they cease to function will transpire quite a lot of water and which they will draw from the sappy stems. The methods to be adopted should therefore aim to keep the leaves limp as long as possible, as whilst in this condition they will be drawing sap away from the stems very effectively. In practice the hay is made as far as possible in the windrows or in heaps or "cocks."

Lucerne may be cut at any time for green feed, and it may be accepted as an axiom that it is better at all times to cut early than late. Some farmers commence to cut the crop for hay shortly after the first flowers have appeared, others when the lower leaves begin to change colour. In some instances this latter may happen and the leaves begin to drop and the stems harden before the blooms appear. Unless the weather is very unsuitable for haymaking the mowing should not be delayed or loss may occur in three ways; in the first place the later cut or more mature material is less digestible. After flowering the food constituents are transferred to the upper portions of the plant, the stems harden and become less digest-

ible than when younger; further some of the leaves wither and drop off and this results in loss in weight. Deferred cutting leads to poorer growth in the succeeding crop and may also result in a lessened number of cuttings during the season because of the greater time which the respective cuttings occupy the land.

The following table showing some results obtained at the Utah Experiment Station in a feeding test indicates the loss of nutriment following upon delay in cutting.

Stage of growth and beef lbs. produced per ton of hay—

When 1-10 in bloom—706 lbs.
When in full bloom—562 lbs.
When 1-2 of blooms have fallen—490 lbs.

At the Kansas Experiment Station results obtained and the decline in the protein content consequent upon later cutting are as follow:—

Stage of growth and protein content—

When 1-10 in bloom—18.5 per cent. protein.
When 1-2 in bloom—17.2 per cent. protein.
When in full bloom—14.4 per cent. protein.

Lucerne at Denmark. Grown by Mr. J. Haire.

The first cutting for hay is ready early in spring, and except in the wheat areas, this crop will be difficult to make into hay on account of its sappy nature and the lack of much sun heat at this time. If this cutting can be used for feeding to stock in its green state it is advisable to use it in this way, or failing this, to conserve it as silage. The second and succeeding crops are much more easily converted into hay. In New South Wales when a crop of seed is required the third crop is usually utilised for this purpose, as the flowering at this period is usually more uniform than at others.

Lucerne is usually mown with a scythe, mowing machine, and on occasions with a reaper and binder; it should be cut as close to the ground as is possible without injuring the blade, so as to get the maximum amount of material and to force the new growth from the crown instead of from the joints of the old stems. The usual practice is to start when fine bright weather is expected and as early in the morning as is possible, but not until any dew which may have been deposited has evaporated. It is **not** desirable that the cut material be allowed to remain in the swathe too long, especially if the weather be hot, for extreme heat causes rapid drying of the leaves, and these are likely to fall off during the subsequent operations. If it is allowed to remain just long enough to wilt during bright fine warm weather, this will take only a few hours, whereas with cool moist conditions it may take as many days. After being wilted the material should be raked at once into windrows. If the day is a bright sunny one and the mower has been started in the morning, the rake can be started at mid-day, and should catch the mower before night. The next morning the material in the windrows can be placed into heaps or "cocks," and if the weather remains favourable it is probable that the lucerne will be fit to stack the following morning.

Sometimes during hot weather the curing is completed entirely in the windrows, which should be made loose so as to admit the air freely, but in cool damp weather it will be advisable to place the material in "cocks" and allow the curing to finish in them. When dry enough or "cured," the hay is ready to be carted for stacking or baling. This is determined by an examination of the stalks, which need not be dry and brittle, but tough, though without any sap being noticeable when the stems are twisted tightly.

Just before carting, the "cocks" are sometimes turned over to expose the bottom hay for an hour or so to the sun, so as to dry off any hay that may be slightly damp owing to its proximity to the ground. Sometimes in very hot weather the hay becomes too brittle as the day advances, and there is a danger of losing the leaves, and the carting has to be confined to the mornings.

The time occupied from mowing to carting will vary with the season and according to the weather prevailing during the operations. Usually it is under three days, but may be as short as 24 hours. An extreme case is known to the writer and is that of Mr. P. Reynolds, "Hobartville," Richmond, who on one occasion stacked his hay in the shed 16 hours after cutting.

Lucerne hay does not shed the rain well, and when stacked in the open should be thatched or protected in some other way from rain. It is best stored in sheds, and should not be stacked on the ground or on a raised straddle of earth; it requires a foundation or straddle of poles to admit air to the bottom of the stack. If stacked on the ground some is sure to spoil.

Summarised.

Lucerne has many virtues. These have been summarised in most picturesque language by Geo. L. Clothier, of whom it is stated by Coburn in the "Book of Alfalfa" that he has studied his subject closely in the field, in the feed lot and the laboratory. His summing up is as follows:—

"The cultivation and feeding of alfalfa mark the highest development of our modern agriculture. Alfalfa is one of nature's choicest gifts to man. It is the preserver and the conserver of the homestead. It is peculiarly adapted to a country with a republican government, for it smiles alike on the rich and the poor. It does not fail from old age. It loves the sunshine, converting the sunbeams into gold coin in the pockets of the thrifty husbandman. It is the greatest mortgage lifter yet discovered.

"The alfalfa plant furnishes the protein to construct and repair the brains of statesmen. It builds up the muscles and bones of the war-horse, and gives his rider sinews of iron. Alfalfa makes the hens cackle and the turkeys gobble. It induces the pigs to squeal and grunt with satisfaction. It causes the contented cow to give pailsfull of creamy milk, and the Shorthorn and whitefaced steers to bawl for the feed rack. Alfalfa softens the disposition of the colt and hardens his bones and muscles. It fattens lambs as no other feed, and promotes a wool clip that is a veritable golden fleece. It compels skim-milk calves to make gains of two pounds per day. It helps the farmer to produce pork at a cent and half a pound and beef at two cents.

"Alfalfa transforms the upland farm from a sometime waste of gullied clay banks into an undulating meadow fecund with plant food. It drills for water, working 365 days in the year without any recompense from man. The labour it performs in penetrating the subsoil is enormous. No other agricultural plant leaves the soil in such good physical condition as alfalfa. It prospects beneath the surface of the earth and brings her hidden treasure to the light of day. It takes the earth, air, moisture and sunshine, and transmutes them into nourishing feed stuffs and into tints of green and purple, and into nectar and sweet perfumes, alluring the busy bees to visits of reciprocity, whereon they caress the alfalfa blossoms, which, in their turn, pour out secretions of nectar fit for Jupiter to sip. It forms a partnership with the micro-organisms of the earth by which it is enabled to enrich the soil upon which it feeds. It brings gold into the farmer's purse by processes more mysterious than the alchemy of old. The farmer with a fifty-acre meadow of alfalfa will have steady, enjoyable employment from June to October, for as soon as he has finished gathering the hay at one end of the field it will be again ready for the mower at the other. The homes surrounded by fields of alfalfa have an aesethtic advantage unknown to those where the plant is not grown. The alfalfa meadow is clothed with purple and green, and exhales fragrant balmy odours throughout the growing season to be wafted by the breezes into the adjacent farmhouses."

"THE JOURNAL OF AGRICULTURE"

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ROYAL AND DISTRICT AGRICULTURAL SOCIETIES 50 ACRE CROP COMPETITION, 1936.

(*Continued.*)

I. Thomas, Superintendent of Wheat Farming.

ZONE 7.

Judge: A. S. Wild, Senior Agricultural Adviser.

Kulin Society, 10 entries; Karlgarin Society, 8 entries; Kukerin Society, 7 entries; Lake Grace Society, 7 entries.

The rainfalls recorded for the year at Kulin, Kulin Rock, Nyabing, Kukerin, Hyden Rock and Lake Grace, are given in the following table:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total.
Kulin	116	8	5	83	165	339	165	221	115	24	1,029	46	89	1,376
Kulin Rock ...	91	...	4	64	135	305	114	223	58	5	840	10	65	1,074
Nyabing ...	36	14	18	22	131	241	105	193	63	12	745	25	80	940
Kukerin ...	126	17	16	131	373	404	116	206	93	15	1,207	21	107	1,625
Hyden Rock ...	90	16	18	93	269	417	124	237	77	34	1,158	36	65	1,476
Lake Grace ...	173	5	32	77	312	343	124	153	46	10	988	32	120	1,427

The results of the four competitions are given below:—

TABLE 1.

KULIN AGRICULTURAL SOCIETY.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Evans, H. ...	Kulin Rock ...	Bencubbin ...	26	9	9	14	13	71
Bele, J. H. ...	do. ...	do. ...	27	8	9	13	13	70
Clayton, J. M. ...	Jitarning ...	do. ...	23	8	9	14	13	67
Bailey & Russell	Kulin Rock ...	do. ...	23	7	9	13	12	64
Freebairn & Kemp	do. ...	do. ...	20	9	9	13	13	64
Meikle, P. ...	do. ...	do. ...	20	8	9	13	13	63
Trotter, A. W. ...	Kulin	do. ...	20	9	7	14	13	63
Bowey, P. J. ...	do.	Sword	18	9	8	14	13	62
Scadding, N. A.	Jilakin... ...	Gluclub ...	20	9	7	12	14	62
Davies, Reg ...	do. ...	Totadgin ...	17	9	9	13	13	61

TABLE 2.

KARLGARIN AGRICULTURAL SOCIETY.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Spurr, E. F. ...	Karlgarin ...	Bencubbin ...	22	9	9	14	13	67
Turner, H. E. ...	North Hyden ...	do. ...	24	9	7	12	14	66
Medcalfe, C. W.	Karlgarin ...	do. ...	21	9	9	12	14	65
Biglin, E. J. ...	do. ...	do. ...	22	8	8	13	13	64
Biglin, D. ...	do. ...	Gluyas Early ...	20	9	8	12	14	63
James, S. W. ...	do. ...	Bencubbin ...	21	8	8	12	12	61
Ray, H. A. ...	do. ...	do. ...	18	9	8	13	13	61
Finemore, A. ...	do. ...	do. ...	19	7	9	12	12	59

TABLE 3.

KUKERIN AGRICULTURAL SOCIETY.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Bahr, E. O. ...	Merilup ...	Gluclub ...	28	9	9	14	13	73
Adams, E. ...	Kukerin ...	Bencubbin ...	28	8	9	14	13	72
Foulkner, W. J.	North Kukerin	do. ...	26	8	9	13	14	70
Smith, A. H. ...	Kukerin ...	Gluyas Early ...	24	8	9	13	14	68
English, J. C. ...	Merilup ...	Bencubbin ...	21	7	9	12	12	61
Sugg Bros. ...	Kukerin ...	Bald Early ...	20	8	8	12	13	61
Pike, G. ...	do.	do.	17	9	8	12	14	60

TABLE 4.

LAKE GRACE AGRICULTURAL SOCIETY.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Darby, A. H. ...	Lake Grace ...	Bencubbin ...	26	9	9	13	14	71
Carruthers, J. ...	do. ...	do. ...	25	9	9	13	14	70
Fry, E. H. ...	North Lake Grace	do. ...	25	9	9	12	13	68
Tunney, S. ...	West Lake Grace	Gluclub ...	25	8	8	12	13	66
Carruthers, W. ...	South Lake Grace	Bencubbin ...	21	8	9	12	13	63
Carruthers, H. F.	Lake Grace ...	do. ...	19	8	9	12	13	61
Carruthers, R. ...	do. ...	Gluclub ...	21	8	6	12	14	61

ZONE 8.

Judge: N. Davenport, Senior Agricultural Adviser.

Royal Agricultural Society, 2 entries direct; Gnowangerup Society, 5 entries; Wickepin Society, 3 entries.

The rainfalls recorded during 1936 at Wickepin, Gnowangerup, Borden, Broomehill and South Caroling are given below:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total.
Wickepin ...	81	...	13	79	405	418	133	181	73	11	1,221	19	171	1,584
Gnowangerup...	97	5	4	76	195	225	100	169	42	20	751	65	42	1,040
Borden ...	88	14	3	52	137	192	139	207	64	44	783	53	76	1,069
Broomehill ...	83	5	9	118	160	239	105	252	88	30	874	58	67	1,214
South Caroling	23	3	43	30	173	348	153	183	70	26	953	14	132	1,198

The results of the competitions are as follow:—

TABLE 5.

WICKEPIN AGRICULTURAL SOCIETY.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Hosken Bros. ...	Wickepin ...	Free Gallipoli...	28	8	8	14	14	72
Doncon. E. E. ...	do. ...	Bencubbin ...	24	9	9	14	12	68
Fleay, E. H. ...	do. ...	Totadgin ...	20	9	9	13	13	64

TABLE 6.

GNOWANGERUP AGRICULTURAL SOCIETY.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts
Cockram, C. ...	Pallinup ...	Free Gallipoli...	30	9	9	14	14	76
Beeck, H. O. ...	Gnowangerup...	do.	27	9	9	14	13	72
Formby & Son ...	do. ...	Bencubbin ...	25	8	9	14	13	69
Davis, N. P. ...	do. ...	Free Gallipoli...	25	9	9	14	12	69
White, R. H. ...	Pallinup ...	Ghurka ...	20	9	9	14	12	64

ROYAL AGRICULTURAL SOCIETY (DIRECT ENTRIES).

Richards, A. ...	South Caroling	Totadgin ...	28	9	9	14	14	74
Taylor, C. ...	Broomehill ...	Bencubbin ...	29	9	9	14	13	74

ZONE 9.

Judge: A. S. Wild, Senior Agricultural Adviser.

Phillips River Society, 4 entries.

The monthly rainfalls recorded during 1936 at Ravensthorpe is as follows:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total.
Ravensthorpe...	79	26	26	36	301	148	177	85	50	27	788	26	35	1,016

The results of the Phillips River competition are as follow:—

TABLE 7.

PHILLIPS RIVER AGRICULTURAL SOCIETY.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Campbell, J. ...	Mt. Short ...	Bencubbin ...	22	9	9	13	13	66
Barrett, T. M. ...	Ravensthorpe	Nabawa ...	20	9	9	12	13	63
Babbington Bros.	Mt. Short ...	Totadgin ...	14	9	9	13	14	59
Chambers Bros....	Ravensthorpe...	Bencubbin ...	14	9	9	13	13	58

The details of the Royal Agricultural Society's zone championship awards are set out hereunder:—

ZONE 1

Judge:—G. L. Throssell, Agricultural Adviser.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts
Lynch, Senator P. J.	Three Springs	Three Springs	Bencubbin	24	9	9	13	12	67
Hebiton, J. K. (jun.)	do.	do.	Merredin	21	9	8	14	12	64
Rudduck, A. ...	Coorow ...	Royal ...	do.	18	9	9	14	12	62

ZONE 2.

Judge:—I. Thomas, Superintendent of Wheat Farms.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
S. C. Harrington	Damboring	Royal ...	Gluclub ...	17	7	8	13	12	57
R. Bradford ...	do. ...	do. ...	Gluyas Early	15	8	7	12	12	54

ZONE 3.

ROYAL AGRICULTURAL SOCIETY.

Judge:—F. L. Shier, Senior Agricultural Adviser.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
F. B. Johnson & Sons	Goomalling ...	Bencubbin ...	24	9	9	13	13	68
T. R. Smith & Sons	do. ...	do. ...	22	9	9	14	13	67

ZONE 4.

Judge :—W. M. Nunn, Agricultural Adviser.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Creagh Bros. ...	Nungarin ...	Nungarin and Eastern Districts	Noongaar	23	9	9	14	14	69
Watson Bros....	do. ...	do.	Bencubbin	22	8	9	14	14	67
Hopwood, B. W. G.	Bencubbin ...	Mt. Marshall	do.	19	8	9	14	13	63
White, E. T. & J. G.	Mukinbudin	Mukinbudin-Lake Brown	do.	16	8	9	12	13	58
Clamp, A. J. ...	do.	do.	Totadgin	18	7	8	12	12	57

ZONE 5.

Judge :—R. P. Roberts, Agricultural Adviser

Competitor.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts
Ellis, E. G. ...	Bruce Rock ...	Bencubbin ...	28	9	9	13	12	71
McPharlin & Sons	Merredin ...	do. ...	24	8	9	14	13	68
Thyme, J. D. ...	do. ...	do. ...	23	8	9	14	13	67
Starcevitch, J. ...	Bruce Rock ...	do. ...	22	9	9	13	13	66

ZONE 7.

Judge :—A. S. Wild, Senior Agricultural Adviser.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Bahr, E. O. ...	Merilup ...	Kukerin ...	Gluclub ...	28	9	9	14	13	73
Adams, E. ...	Kukerin ...	do. ...	Bencubbin	28	8	9	14	13	72
Darby, A. H. ...	Lake Grace...	Lake Grace...	do.	26	9	9	13	14	71
Evans, H. ...	Kulin Rock	Kulin ...	do.	26	9	9	14	13	71
Bele, J. H. ...	do.	do. ...	do.	27	8	9	13	13	70
Carruthers, J....	Lake Grace...	Lake Grace...	do.	25	9	9	13	14	70
Spurr, E. F. ...	Karlgarin ...	Karlgarin ...	do.	22	9	9	14	13	67
Turner, H. E.	North Hyden	do.	do.	24	9	7	12	14	66

ZONE 8.

Judge :—N. Davenport, Senior Agricultural Adviser.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Cockram, C. ...	Pallinup ...	Gnowangerup	Free Gallipoli	30	9	9	14	14	76
Richards, A. ...	South Caroling	Royal ...	Totadgin...	28	9	9	14	14	74
Taylor, C. ...	Broomehill ...	do. ...	Bencubbin	29	9	9	14	13	74
Beeck, H. O. ...	Gnowangerup	Gnowangerup	Free Gallipoli	27	9	9	14	13	72
Hosken Bros. ...	Wickepin ...	Wickepin ...	do.	28	8	8	14	14	72
Doncon, E. E.	do. ...	do. ...	Bencubbin	24	9	9	14	12	68

ZONE 9.

Judge :—A. S. Wild, Senior Agricultural Adviser.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Campbell, J. ...	Mt. Short ...	Phillips River	Bencubbin	22	9	9	13	13	66
Barrett, T. M.	Ravensthorpe	do.	Nabawa ...	20	9	9	12	13	63

This year 73 entries were received from 13 district agricultural societies, while seven entries were made direct with the Royal Agricultural Society. The following table shows the number of competitors and the average yield obtained each year since the competition was inaugurated:—

Year.	Number of District Agricultural Societies Competing.	Number of Competitors.	Average Yield of Competitors.	Average Yield for State.
			Bus.	Bus.
1921 ...	...	15	25	10·4
1922 ...	...	32	24	8·9
1923 ...	12	82	29	11·4
1924 ...	15	70	31	12·8
1925 ...	13	59	22·5	9·7
1926 ...	11	99	24·5	12·0
1927 ...	10	100	26·9	12·1
1928 ...	13	114	22·5	10·1
1929 ...	12	156	21·7	11·0
1930 ...	15	165	27·4	13·3
1931 ...	13	110	27·4	13·1
1932 ...	17	168	29·3	12·3
1933 ...	17	130	27·2	11·7
1934 ...	17	114	26·8	9·8
1935 ...	16	97	24·8	9·2
1936 ...	12	80	21·0	8·2*

*Estimate.

The special prize of £5 5s. for the competitor obtaining the highest calculated yield per acre was awarded this year to C. Cockram, of Pallinup, who obtained a yield of 30 bushels with the variety "Free Gallipoli."

	Bus./Acre.
1925—Hebiton & Sons, Three Springs, "Nabawa" ..	34
1926—Cuming Bros., Carnamah, "Yandilla King" ..	38
1927—A. W. Parkinson, Gnowangerup, "Yandilla King," ..	40
1928—A. W. Parkinson, Gnowangerup, "Yandilla King" ..	40
1929—C. E. Cockram, Pallinup, "Yandilla King"	46
1930—C. Smith & Sons, Yarding, "Gluclub"	43
1931—H. O. Beeck, Gnowangerup, "Yandilla King," ..	42
1932—F. S. Freebairn, Jilakin, "Gluclub"	47
1933—D. Davis, Gnowangerup, "Bencubbin"	43
1934—C. E. Cockram, Pallinup, "Free Gallipoli"	40
1935—E. Davis, Gnowangerup, "Bencubbin"	41
1936—C. E. Cockram, Pallinup, "Free Gallipoli"	30

GOVERNMENT CERTIFIED EARLY (DWALGANUP) SUBTERRANEAN CLOVER SEED.

The attention of farmers and seed merchants is drawn to the fact that two grades of purity are recognised in Government certified early (Dwalganup) Subterranean Clover seed, viz.:—(a) not less than 98 per cent. pure seeds, and (b) not less than 96 per cent. pure seeds. The tags and slips associated with seed produced during the current season, besides bearing the respective purity figures, are of two colours, red representing the 98 per cent. and blue the 96 per cent. purity standard. As previously, figures concerning germination may be obtained by forwarding the certificate number noted on the tag and slip to the Government Botanist, Department of Agriculture, Perth.

GRASSHOPPER PLAGUE.

(*AUSTROICETES JUNGI*)

L. J. Newman, F.R.E.S., Entomologist, Department of Agriculture.

It is unfortunate that many farmers and others fail to realise the potential danger which lurks in a few handfuls of grasshoppers. If the small swarms were diligently sought after and destroyed as soon as they are observed, we would not later have to deal with the great swarms which appear at various intervals.

As soon as conditions become favourable, these solitary forms of grasshoppers merge together and form minor swarms. Given a season of light rainfall the following year, the eggs deposited by the minor swarms practically all hatch, resulting in a large swarm. If it so happens that the following season the climatic and other factors are again favourable, we suffer a disastrous plague such as experienced during the spring and early summer of 1936.

It is manifestly impossible to deal with every single grasshopper or very small scattered lots in the vast thinly-populated north-eastern and eastern wheat lands, where the plague grasshopper habitually occurs, but it is very essential that minor swarms, when observed, be effectively dealt with, as they are the progenitors of the possible future plague. If the small swarms were diligently sought and destroyed as soon as found, we need not suffer the unequal battle of trying to poison off overwhelming numbers.

The grasshopper in our wheat areas appears in gregarious swarms, but does not migrate long distances. It is more or less localised, its normal distribution by flight not exceeding 20 miles. In dealing with a pest of this sort, it is most essential that there should be combined action among all concerned, as the efforts of individuals are wasted if action is not taken by neighbours to destroy the hoppers before they reach the winged form.

The great need is not so much for more officers as it is for more intelligent, active interest and co-operation on the part of the farmers concerned.

The swarms during the past spring and early summer were the largest and most widespread ever witnessed in our wheat areas. Previous to the year 1935-36, the most serious swarms occurred in the spring of 1926. These swarms, although damaging to the actually infested areas, were limited in extent. The reason for this limitation of the outbreak in 1926 was due to two important factors. (1) The area suffering from lack of rain was not so extensive; (2) the area of abandoned properties was comparatively small.

This species of grasshopper is widespread in our drier areas and is native there.

It is only since the disturbance of the balance of nature, by the clearing of the land of trees and scrub in these parts, that this pest has assumed importance as an economic trouble.

What has really happened is that the removal of the timber and cultivation of the land has produced a greater supply of grass and cereal crops, thus supplying an abundance of food not present under natural conditions. Just so long as these cleared lands were kept under rotational cultivation there was no serious increase of the pest, but when, however, large areas were abandoned, owing to the fall in the value of wheat, the grasshoppers took possession, and as insects largely increase in numbers according to the available food supply, it can be readily understood that as the food of this grasshopper is grasses or cereals, the insect was in clover, so to speak. When combined with favourable climatic and other factors these unworked areas give rise to periodic swarms.

There is a fear in the minds of some farmers that this grasshopper will spread to all parts of the wheat areas. I would point out that such a fear is groundless, as this particular species is essentially confined to light rainfall

Adult or full-grown Locust (*Austroicetes jungi*).

areas. Rainfall is the chief factor in regard to the successful hatching of the eggs, the water content of the soil determining to a very great extent their healthy incubation.

Pre-winged hopper stage.

There must of course be some moisture in the ground where the eggs are laid, otherwise they will not hatch. The ideal hatching conditions noted are light autumn and following light winter and spring rains. Under these subnormal conditions the soil never becomes completely saturated. In such circumstances a comparatively warm incubation soil condition is set up which is very

favourable to the healthy hatching of the eggs in July-August. If, on the other hand, the autumn and winter rains are copious, the soil condition becomes saturated or perhaps super-charged with moisture. This tends to lower the soil temperature to some extent and thus retards the development of the eggs. If such conditions are maintained for some time, the eggs rot in the ground and

Section of soil showing uncapped Locust Egg Pods from which young have issued.

in many instances, fungus growths, which are not plentiful during dry years, again make their appearance and very appreciably aid in the destruction of the eggs. There have been a few instances where the hoppers have appeared in damaging numbers in our wetter wheat areas, but this is no doubt due to the unusually dry conditions during the past two years. With the return to normal weather, they will cease to be troublesome.

In the study of this grasshopper, efforts have been made to discover any natural insect parasites. Large numbers of eggs from different districts at varying periods have been collected and incubated, but to date no specific parasite has been observed. There have been found several predatory insects, which attack both the eggs and hoppers. These, however, are not specific parasites, being general feeders on various insects and consequently are only more or less accidental on the grasshopper, making no appreciable reduction in their numbers. The egg parasite reported from Eastern Australia, *Scelio chortoicetes*, is confined to the eggs of a different species of plague grasshopper Our plague species is also found in the Eastern States, but to date no effective egg parasite has been discovered.

In the face of these facts, control of this pest by the introduction of egg parasites does not appear, at present, to be very hopeful.

The first line of attack must be to break up all known egg-infested lands. It is presumed that farmers have been interested sufficiently to have observed the areas within and around their own properties wherein grasshopper eggs have been deposited. It must be recognised that all grasshoppers do not emanate only from abandoned properties—any land of a suitable nature for egg deposition, which has been left unworked for more than three years may become a breeding centre. Road sides and other such areas are also fruitful breeding grounds.

To get maximum results the egg-infested land must be thoroughed worked to break down all lumps. If this is not done, many of the egg pods within the lumps will remain undisturbed and unexposed and thus these eggs will hatch, greatly reducing the effectiveness of the working of the egg beds.

The breaking-up should be done as soon after the eggs have been deposited as is possible. By so doing, the eggs are exposed to the hot sun, birds and many predatory insects. It is recognised that the grasshoppers often select for their egg-laying grounds, land which is mostly unworkable during the dry season of the year. Such country, if infested, should be worked as soon as rains have rendered it workable. Not only does the working of the land expose and destroy the eggs, but it accomplishes a double purpose, in that it renders the land so treated unsuitable for egg-laying the following spring.

The breaking of the egg-infested areas is the most effective artificial measure of control and every possible effort must be made to bring back to cultivation all abandoned lands.

Photo. by W. N. Hedges.

During the spring of 1936 the Government again made available large quantities of free poison-baiting material. Unfortunately, in some districts this was not availed of as much as it should have been. There is no doubt that where availed of and used systematically and thoroughly, many millions of grasshoppers were destroyed.

During the campaign in the Narembeen Road Board area, it was demonstrated that the poison bait could be effectively distributed per medium of Superspreaders. Two of these machines were brought into use on the property owned by Mr. W. N. Hedges. They were mounted on motor lorries and driven by a cog chain connected to the back wheel of the motor. The distribution of the bait by this means assured that it was scattered in the necessary fine particles, lumps being impossible. Mr. Hedges also devised a means of mechanically mixing the baiting ingredients.

This consisted of a circular drum or tank, which rotated about an axle fitted with a number of fixed arms or agitators. The tank was rotated by a belt attached to a small motor. The two accompanying photos. illustrate the device mounted on a waggon for transport to the various areas requiring the bait. By the use of these methods, much manual labour and man-handling of the baiting material is eliminated.

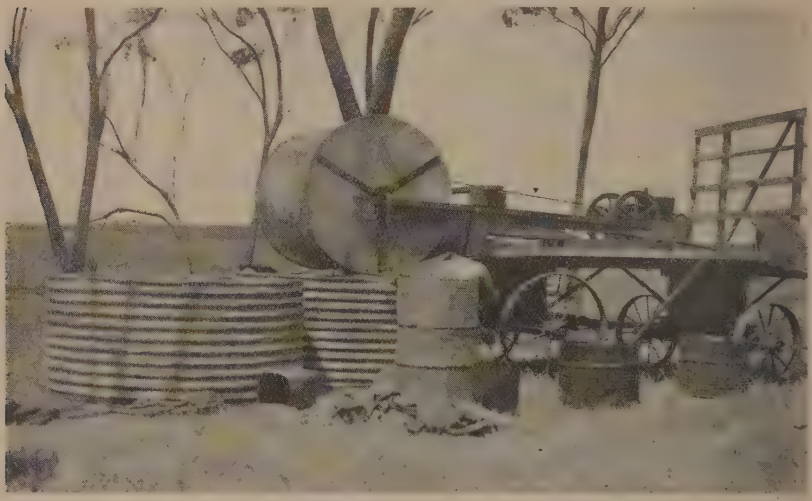

Photo. by W. N. Hedges.

It is sincerely hoped that the coming season will see the definite breaking of the spell of sub-normal rainfall years just experienced and that the natural factors will be favourable to healthy crops free from grasshopper invasion. If grasshoppers do appear in any areas during July or August, their presence should be promptly reported to district Agricultural Bank officers or the Department of Agriculture.

HOPS.

G. H. BURVILL, Agricultural Adviser.

Summary.

During recent years the production of hops has been successfully carried out at Pemberton in the extreme South-West of Western Australia.

In this article, for the information of growers and others interested, the characteristics of the hop plant and its fruits are outlined. The cultivation and manuring of hops are discussed with special reference to Western Australian conditions. Manurial recommendations are made on the basis of general considerations and from analyses of hop plants and fruits. Harvesting and drying information are given, including brief data of the most modern English drying practices.

Historical and Introductory.

According to Simmonds (1) hops are mentioned by the Arabian physician Mesué who lived about 845. However, as far as is known, their use for preserving beer dates back to the 14th century only, when they were used in the breweries of Germany and Holland. The introduction of hops to England from Flanders took place in 1524, but they were not generally used in English beer till about 1600. Hops were used for medicinal and prophylactic purposes as well as for preserving beer, and they have also been commonly used for the cultivation of yeast for breadmaking.

The hop is widely distributed in cool temperate climates and it grows wild in England, Europe, Asia and North America. In many countries, including Australia and New Zealand, it is grown commercially and the biggest producers of hops are United States of America, England, Czecko-Slovakia and Germany.

In Western Australia commercial hop growing is so far confined to about 12½ acres near Pemberton, and production for 1935-36 was 6,174 pounds of dried hops. Most of the hops used in Western Australia are imported from Tasmania and Victoria, about three quarters of the total imports coming from Tasmania and most of the remaining quarter from Victoria. The imports for the past three years are set out below:—

IMPORTS OF HOPS INTO WESTERN AUSTRALIA.*

	Weight. pounds.	Value. £
1933–34	162,992	12,429
1934–35	217,295	18,857
1935–36	208,632	19,561

*Data supplied by Government Statistician.

Botanical Characters of the Hop Plant.

Botanically, the cultivated hop (*Humulus lupulus*) belongs to the mulberry family (Moraceae), a group which also includes the fig and hemp (*Cannabis sp.*). It is a perennial herbaceous climbing plant which dies back to the ground during winter and makes fresh growth from the underground root-stock during the following spring and summer. Male and female flowers are carried on separate plants, but only the female flowers produce the "hops" of commerce. New areas of hops are not established from seed, but from cuttings or "sets" obtained from the root-stocks of, or the runners sent out near ground level by, established plants. The hop fruits are considered to develop better and give a heavier yield if the female flowers are fertilised, and so it is customary to plant about one male plant per 100 female plants. The Continental hop crops are, however, grown without seed, giving lower yields per acre than in England and America, where male plants are used. Male plants are included in Australian hop gardens.

As with other crop plants, there are numerous varieties of hops, those grown in Western Australia including Californian, Golden Cluster and Bavarian.

Preservative Value of Hops.

The hops of commerce are also called "burrs" or "strobiles." They develop from the clusters of female flowers, each "hop" actually consisting of a number of flowers below each of which is a papery leaf like structure known as a bracteole. On the outer surface of these bracteoles and on the perianth of the flower are pollen-like grains of the "hop meal," or "lupulin," in which occur the resins which give hops their preservative properties. Besides resins, the lupulin glands contain a small amount of hop oil, and both oil and resins contribute to the character-

istic flavour of hops. The valuation of hops is performed either by hand examination by experienced brewers, or by chemical analysis to determine the amount and composition of the resins. Only the soft resins are considered to contribute to the preservative value, and of these what is known as the alpha-fraction (α) is more valuable than the beta-fraction (β). The percentage of alpha-resins plus one-third of the percentage of beta-resins is taken as a measure of preservative value.

The Growth of Hops in Western Australia.

Hops are being grown commercially in the Pemberton district where the climatic conditions during the comparatively cool summer months appear favourable.

The average rainfall at Pemberton over a period of 21 years up to 1935 inclusive, is as follows:—

Month.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Rainfall (points)	83	110	126	284	810	917	992	812	591	463	179	123	5,490

The hop plants, which remain dormant during the winter, shoot away about September-October and the harvesting of the hops takes place about March.

Soils.

Hops are commonly grown on alluvial soils and are sometimes irrigated. So far, however, at Pemberton, they are being grown on grey and brown powdery and sandy loams of the karri slopes where there is good natural drainage for the very heavy winter rains. Some of the hop garden soils examined have shown a clay subsoil at about two feet; others showed little change in texture, or became only a little more clayey with depth, from the surface to depths of 30 inches.

English experience (2) has shown that hops can be grown on a variety of soils, though acid conditions are not considered favourable and dressings of lime are recommended to overcome this condition. The soils examined from Pemberton are moderately acid (pH 5.3 to 6.1), but the need for lime must be determined by experience, for, of numerous experiments with lime for crops and pastures on the slightly to moderately acid soils of the South-West, few have shown any definite response to lime. The hop plant, like many other crop and pasture plants, such as wheat, oats, and subterranean clover, probably does well on soils which are moderately acid (pH 5 to 6), but a high degree of acidity would prove deleterious, and require correction by the use of lime.

Areas kept moist by slight seepage should be advantageous for the growth of hops provided the ground is not waterlogged during the winter months, for, despite the high rainfall of our extreme South-west areas as exemplified by the figures for Pemberton, the winter incidence of the rains is most marked. The months November to February inclusive, when the hops make most of their growth, receive on the average at Pemberton only 495 points out of an annual average of 5,490 points, *i.e.*, less than 10 per cent. of the annual rain.

Planting New Areas.

Plantings of new areas are made in September on well prepared land. The "sets" are planted in rows six to seven feet apart and with four to six feet between plants in each row, so that an acre will accommodate 1,200 to 1,500 plants. As previously mentioned, one male plant is usually included per 100 female plants. "Sets" for planting are usually obtained from an established hop garden.

For supporting the vines a system of overhead wires carried on stout poles about 18 feet high is provided, with a wire directly above each row. The vines are trained up strings of binder twine attached to these wires. Karri poles are used at

Pemberton. An acre of hops requires about 80 poles, 6,500 feet of 10-gauge wire (equals about 2½ coils) and 1½ bales of binder twine. The latter serves, of course, for only one year's growth and must be renewed each year.

Cultural Practices.

Hop gardens do not usually reach full bearing till their third year, but thereafter yields of dried hops may range between 10 and 20 cwts. per acre—in fact, Salmon (3) records a new variety (Cats' Tails) at the South-Eastern Agricultural College in Kent, England, which in 1934 yielded 36¼ cwts. per acre. With prices between 1s. 6d. and 2s. per pound, the gross return per acre may thus be from £100 to £200, and so the hop crop deserves careful and intensive treatment in all the cultural and manurial practices associated with it.

Australian hop gardens usually receive a winter ploughing in May. The next ploughing is done in August when a basal fertiliser dressing is ploughed in along with weeds, and cover crops if such have been planted. Pruning of the previous season's vines (or bines as they are sometimes called) is carried out prior to the August ploughing. The gardens may receive two more ploughings and several harrowings between August and January.

The influence on yield of various systems and numbers of cultivations has been studied for some years at the South-Eastern Agricultural College in Kent. The chief study is to determine the effects of deep cultivations after the spring ploughing, such cultivations being continued at intervals to various stages in the growth of the hop plants. For instance, some plots receive no deep cultivations after the spring ploughing, while on other plots deep cultivation is continued till the hop fruits are in a stage of development known as the "pin" stage. Differences in yield have usually been found in favour of plots receiving at least some deep cultivation after the spring ploughing, though none of the differences is large.

While these findings may not be strictly applicable to Western Australian conditions, it is suggested that no economic advantage may result from ploughings and cultivations during the growth of the hops, unless these are done with the object of removing weeds, or to loosen caked surface soil so that rainfall may enter the soil instead of perhaps running off over the surface.

Manuring.

Many experiments in England have shown the hop plant to be a general feeder with no special manurial requirements. General considerations of soil and climate, together with local experience, must therefore form a basis for manurial practices. It has been traditional in English hop growing practice to use each year large amounts of organic manures such as stable manure, shoddy, rabbit waste, meat meal, fish meal, rape dust, guano, etc., especially as a source of nitrogen, but it has been shown both in England and Germany (2, 4) that the use of mineral manures alone has caused no reduction in the yield or quality of hops. Burgess (4) reports, however, that using minerals alone, the soil may become difficult to work after a number of years. The latter effect is unlikely to occur under Western Australian conditions, for during the winter months cover crops and weeds may be grown to be ploughed under with the August ploughing. These will improve the soil as a medium for plant growth and offset any harmful effects of mineral fertilisers on the soil texture and structure.

With a crop grown under intensive conditions and giving high acre yields of produce as does the hop crop, it is wise in fertiliser practice to take account of the amounts of the important plant foods, nitrogen, phosphoric acid and potash removed per acre by each year's crop.

Data from four sources gave the following ranges of figures for the nitrogen, phosphoric acid and potash contained in hop crops:—

Nitrogen (N)	...	...	...	58–129 pounds per acre.
Phosphoric Acid (P_2O_5)	...	...	...	19– 86 „ „
Potash (K_2O)	...	...	...	44–132 „ „

In three cases it was indicated that the figures referred to the hop fruits plus the bines and leaves, but in only two cases was the weight of the crop given. In view of the wide range of the above figures some data for Western Australian hop gardens were sought. Through the courtesy of Mr. J. J. Bunn, of Pemberton, two hop plants from a heavy yielding portion of his gardens were taken at hop picking time (March, 1936) and analyses subsequently made of the leaves, bines and dried hops. In Table 1 are summarised the data from this work.

TABLE 1.

WEIGHTS OF GREEN MATERIAL, AIR DRY MATERIAL, AND PLANT FOODS PER ACRE IN PEMBERTON HOP CROP, 1936.

Part of Plant.	Green Weight.	Air Dry.	Nitrogen N.	Phosphoric Acid P_2O_5.	Potash K_2O.
	pounds per acre.	pounds per acre.	pounds per acre.	pounds per acre.	pounds per acre.
Hops	5,760	1,650 = 14·73 cwt.	31·5	10·9	34·2
Leaves and leaf stalks	5,760	1,700	16·5	3·0	19·6
Bines			6·2	1·2	9·9
Total	11,520 = 5·14 tons	3,350	54·2	15·1	63·7

The figures reveal that a hop crop of 14.73 cwts. per acre, which, though above average, is not exceptional, removed comparatively large amounts of nitrogen and potash and rather smaller amounts of phosphoric acid. Fertiliser practice with hops, as with other perennial fruit crops such as apples, citrus, bananas, etc., should aim, not only at making up for any proved plant food deficiencies in the soil, but also at preventing the soil from becoming gradually depleted of other plant foods. Work on apple trees discussed by Sutton (5) showed that not till *four years* after potash fertilisation was commenced did apple trees *commence* to show any improvement from their condition of potash starvation which resulted from a gradual depletion of the potash in the soil.

Nitrogenous manures, usually sulphate of ammonia, are applied to hops at intervals during the growing season depending on the appearance of the crop. Excess is likely to cause too luxuriant growth of bines and leaves, which inhibits the normal development and ripening of the hops. In manuring hops, the grower's object should be to supply a surplus of potash and phosphate and to apply nitrogenous top dressings so that the crop shall have exactly the right amount at the right time (Amos (6)). Under Western Australian conditions hop growers should endeavour to reduce the necessity for dressings of expensive nitrogenous fertilisers by the growing and ploughing in of cover crops. For preference, leguminous crops such as lupins, subterranean clover and peas should be grown as these are able to fix atmospheric nitrogen, which, when the crops are turned in and decompose, becomes available for the use of the hop plants. The August ploughing of a hop garden

will turn in cover crops and weeds while the ground is still moist enough for their decomposition to occur. The addition of organic matter by this means will also tend to increase the moisture holding capacity of the surface soil.

With regard to phosphate fertilisation, marked responses are general with most crops on Western Australian soils and it is, therefore, safe to assume the need for phosphatic fertilisers with hops. Not more than a small proportion of the phosphate applied is usually recovered in a crop and so the amount of phosphoric acid removed by the crop does not indicate the amount to be applied in fertiliser. If cover crops are grown, the application of 1 to 2 cwts. of superphosphate in autumn will no doubt greatly improve the cover crop.

Responses to potash fertilisers in Western Australia have been few, but as pointed out earlier it would be unwise to grow hops without potash for fear of ultimate serious impoverishment of the soil. The figures of Table 1 indicate that the hop crop may remove per acre 63.7 pounds of potash, equivalent to approximately 130 pounds of sulphate or muriate of potash, and at least this amount should be applied annually.

Referring back to Table 1 it is seen that somewhat less than half the nitrogen, phosphoric acid and potash is contained in the leaves and bines and so every endeavour should be made to return as much as possible of these to the soil of the hop gardens. Unfortunately, the long ropes of tough bines are not easily ploughed in and would probably decompose only slowly, so that they are usually dragged into heaps and out of the gardens and burned.

Manurial Recommendations.

No experimental data on the manuring of hops in Western Australia are available, but from the data of Table 1 and from general considerations, the following recommendations are made:—

Basal fertiliser dressing to be ploughed in in August.

5 to 10 cwts. per acre of a mixture containing:—

2 parts of sulphate of ammonia.
6 parts of superphosphate.
2 parts of sulphate or muriate of potash.

If a *cover crop* is grown 1 to 2 cwts. per acre of superphosphate should be applied in autumn and a correspondingly smaller amount in August.

During the growth of the hops *top dressings* of sulphate of ammonia up to a total of several hundredweights per acre should be applied at intervals determined by the colour and vigour of the plants.

As stated earlier, the need for applications of lime must be determined by experience.

Ready mixed mineral fertilisers are available containing nitrogen, phosphoric acid and potash in approximately the same proportions as the 2:6:2 mixture recommended above. These are sold as Potato Manure H, Potato Manure No. 8, and Potato Special.

Harvesting.

Hops are harvested in Western Australia during February and March. The more exact date is determined by the season and the varieties being grown. When ready for picking the hops change from green to a more yellow colour while the lupulin glands alter from bright yellow and transparent to pale yellow and opaque. Men, women and children participate in the picking, which is done by hand. The hop vine is pulled to the ground by breaking the supporting string, and the hops picked into hessian containers supported on wooden frames and

provided with handles for transport to the drying kiln. Individual pickers will pick from 50 to 150 pounds of green hops per day, depending on their skill. Payments for picking vary, one figure being 6s. per 100 pounds of green hops, with keep provided for the picker.

Drying.

The drying process is considered the most difficult operation in hop production and an excellent sample of green hops may be easily ruined in the drying process. The operation is carried out in a kiln, which has the furnaces or other source of heat at ground level, and a floor of battens, gauze and hessian 10 to 12 feet up on which the green hops are loaded for drying. Cooling rooms and equipment for pressing the hops into bales are also associated with the kiln. For best results, it is necessary that the kiln shall have sufficient draught and a controllable and efficient source of heat. Recent investigations in England discussed by Burgess (7) show that natural draught may be insufficient, and he states *inter alia*, "in my opinion the greatest single improvement that can be made to a natural draught kiln is the provision of a fan, the cost of which is soon repaid by the higher value of the hops dried." Hops are loaded into the kiln not more than one foot deep, and dried by a current of hot air controlled so that their temperature is kept between 100 deg. and 120 deg. F. at first, and rises towards the end of the process, which occupies 8 to 11 hours, to not more than 160 deg. F. Higher temperatures depreciate the market value of the hops. To give the hops an even yellowish colour, sulphur may be burned below them in the kiln. Coal, coke, wood and charcoal have all been used for heating the kilns, also steam in pipes. Thermostatic control has been introduced on various types of heaters, of which the most modern is the open oil flame.

After drying and cooling, hops are packed into wool bales for transport to market. The packing is done in a press capable of applying considerable pressure, so that as far as possible deterioration of the hops by contact with the air is avoided. Each bale of hops weights about two hundredweights.

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BRANDING OF SHEEP.

A. Arnold,

Registrar of Brands, Department of Agriculture.

It has been noted that sheep breeders in many instances are failing to comply with the recent provisions of the Brands Act, which requires that all sheep must bear a registered wool brand. This procedure is compulsory on all owners of sheep in the South-West Division of the State, and it is a further necessity, having so marked them, that the wool brands be kept legibly clear and discernible from time to time, as it is an offence for anyone to have unbranded sheep in his possession. This applies both to the sheep earmark and wool brand, the only exception being sheep under the age of six months. The wool branding clause was especially introduced to minimise, as far as possible, the stealing of sheep, as well marked sheep are more readily traced.

Sheep are invariably earmarked by the breeder; this is a permanent mark, but such sheep, per medium of saleyards, may have several owners during their life-time, hence the necessity for the application of the wool brand to denote the most recent ownership. If a breeder omits to woolbrand his sheep, it would be very easy for an evilly-disposed person to drive off a number on to his own holding and place his wool brand on them, and the rightful owner may have very great difficulty in proving his ownership of them, especially if on some previous occasion he had sold sheep of his own breeding and bearing his earmark. If, on the other hand, the breeder had also woolbranded his flock, the possibility of stealing is minimised, as the evilly-disposed person would think twice before attempting malpractice, as any alteration to the wool brand would be easily discernable, and there would not be the direct invitation to him that exists if the wool brand is not applied. Therefore, it is in the breeder's interest to correctly woolbrand his sheep with his registered wool brand; but it is noticed that there are many instances where the wool brand clause of the Act is being ignored, and failure to comply renders the person in possession liable to prosecution.

It has also been noted recently since prominence has been given to the branding of stock that there are those who are marking their stock with unregistered brands and earmarks. This is a most serious offence, as no earmark or wool brand must be used unless registered as such. Further, in such a case the offence is aggravated, and becomes more complicated in that the mark used is often enough the registered mark of another person—thus neither earmark nor wool brand shall be used unless registered, otherwise the person doing so is liable.

The registration fee for sheep earmark is 7s. 6d. The wool brand is also registered in conjunction with the earmark and no fee is charged, and it is customary to register as such the same characters of the same owner's horse and cattle firebrand, thus keeping all brands uniform for the one holding. The characters of the registered horse and cattle firebrand, however, should not be used as a woolbrand unless definitely registered as such. If a person has a registered sheep earmark, but no registered woolbrand, all that is necessary to secure a woolbrand is to forward the certificate for the sheep earmark registration to the Department of Agriculture, Perth, with a request that a woolbrand be registered, and at the same time stating clearly the characters of his horse and cattle firebrand, when registration will be effected and certificate indorsed and returned, no fee being necessary in this case.

PASTURE DEVELOPMENT.

G. K. Baron-Hay, Superintendent of Dairying, and
H. G. Elliott, Agricultural Adviser.

Second year's report on the Irrigated Rotational Grazing Demonstration being conducted by the Department of Agriculture in conjunction with the Australian Dairy Council on the property of Mr. A. E. Jackson, Roelands.

A resumé of the first year's operations was published in the March, 1936, issue of this Journal.

The area of the demonstration is 12.859 acres. The area of irrigated pasture was increased from the original 10 acres during the early part of 1936, and full grazing was obtained over the whole area from 1st May, 1936.

The objects of the demonstration included—

1. The collection of information as to whether it would be more profitable to establish permanent pasture with a cover crop than to sow the permanent perennial pasture alone.
2. The collection of data regarding carrying capacity on small irrigated areas.
3. The collection of data to show the change in composition due to rotational grazing under irrigated conditions.
4. The production of butter fat per acre and per plot along with the cost of fertiliser per lb. of butter fat produced.
5. The monthly yield per acre of green material.

The soil type, seed mixtures, fertilisers, cultivation, irrigation, and cover crops for each plot were given in detail in the previous report, and are briefly as follows:—

All seed mixtures were sown from 8th to 12th November, 1934.

The following standard seed mixture was applied to all plots:—

Paspalum dilatatum 10 lb. + Certified New Zealand White Clover 2 lb. per acre, the additions being as follow:—

Plot 1.—Standard mixture + Sudan Grass 7 lb. per acre.

Plot 2.—Standard mixture + Italian Ryegrass 7 lb. per acre.

Plot 3.—Standard mixture + Japanese Millet 5 lb. per acre.

Plot 4—Standard mixture + Perennial Ryegrass 7 lb. per acre.

Plot 5.—Standard mixture.

The following gives further results of the experiment for the year ending 31st December, 1936.

Fertiliser.

The rate of application of fertiliser for the second year ending December, 1936, was much lower than that of the first year, being 374 lb. superphosphate and 28 lb. sulphate of ammonia. This was applied as follows:—

1 cwt. super per acre in January just prior to watering.
1 cwt. super + 28 lb. sulphate of ammonia per acre in April.
150 lb. super per acre applied early in November.

Table 1 gives the quantity and cost of fertiliser for the production of butter fat per acre for 1935 and 1936.

TABLE 1.

Year.	Lbs of Fertiliser per lb. of Butter Fat produced.	Super. per Acre.	Sulphate Ammonia per Acre.	Total Fertiliser per Acre.	Total Expenditure per Acre—			Cost of—		
					for Super.	for Sulphate Ammonia.	for all Fertiliser.	Super. per lb. of Butter Fat.	Sulphate Ammonia per lb. of Butter Fat	Fertiliser per lb. of Butter Fat
	lbs.	lbs.	lbs.	lbs.	s.	s.	s.	d.	d.	d.
1935 ...	2·815	904	218	1,122	29·25	24·50	53·75	0·88	0·738	1·618
1936 ...	0·786	374	28	402	12·47	2·48	14·95	0·292	0·058	0·350

NOTE.—Butter Fat produced—1935 = 398·6 lbs. per acre.
1936 = 511·3 lbs. per acre.

From the above table it will be seen that the cost of fertiliser per lb. of butter fat produced in 1935 was 1.618d., and for 1936 it was 0.35d. The figure for 1935 approximates that obtained from the Better Dairying Competition, 1934-35, shown on Table 2 below, but, in the case of irrigated pasture, the production was 398.6 lbs. of butter fat per acre against 48.6 lbs. per acre in the case of the Better Dairy Farm Competition. The total amount of fertiliser used per acre was 1,122 lbs. and 180 lbs. respectively.

In 1936 511.3 lbs. of butter fat was produced per acre, but only 402 lbs. of fertiliser was applied.

The production of 6,793.5 lbs. of butter fat and 13,018.4 gallons of milk from an area of 12.895 acres constitutes a record for the State. The highest production previously obtained from an irrigated pasture was 156 lbs. per acre on a private holding.

The following Table 2 gives the quantity and cost of fertiliser for production of butter fat obtained from dry land farming in the Better Dairying Competition for 1934-35 and 1935-36.

TABLE 2.

Year.	Lbs. of Fertiliser used per lb. of Butter Fat Produced.	Average Super. Applied. (lb. per acre.)	Total Expenditure for Fertiliser per Acre.	Cost of Fertiliser per lb. of Butter Fat.
	lb.	lb.	s.	d.
1934–35	3·70	179·8	6·66	1·683
1935–36	3·72	161·3	5·37	1·488

Butter Fat per acre—1934–5 = 48·6 lbs.
1935–6 = 63·76 lbs.

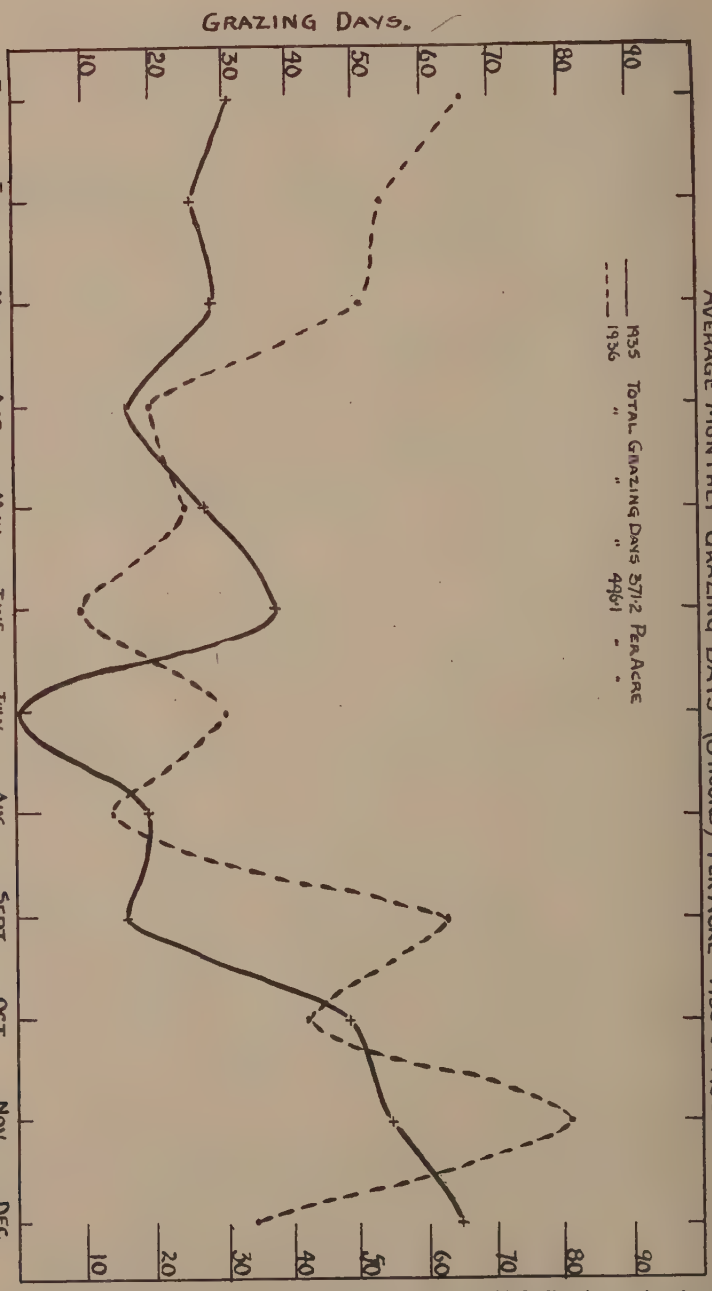
Cultivation.

The plots were harrowed four times during the season, once prior to watering in February, twice during the winter, and again in November. The whole area was mown during April and the surplus material raked off.

Watering.

Four waterings were given during the twelve months ending 31st December, namely, 19th February, 21st February, 25th March and 6th December, 1936. The cost of the four waterings was 15s. per acre.

Graph 1.



LEGEND. GRAPH 1.—The above Graph shows a rapid decline in grazing from the month of March to August. This is due to the effects of the cold and wet conditions during the months April to August. Experiments are now under way to endeavour to increase grazing during these months by treatment involving cultivation and the use of special fertilisers.

Grazing.

Graph 1 on page 38 gives the actual grazing obtained per acre for the years 1935 and 1936.

From the above graph it will be seen that 371.2 grazing days were obtained per acre for 1935 and that 496.1 were obtained during the season 1936. The 1936 production shows a rapid decline during December. This was brought about by the extreme dry conditions during the latter part of the season, and it would have been profitable to have applied the water early in November. Owing to the lack of irrigation, growth was arrested and a number of plants were burnt back to the main roots. The production during the winter months of 1936 was much higher than for the same period of 1935.

The full grazing production for 1935 and 1936 was as follows:—

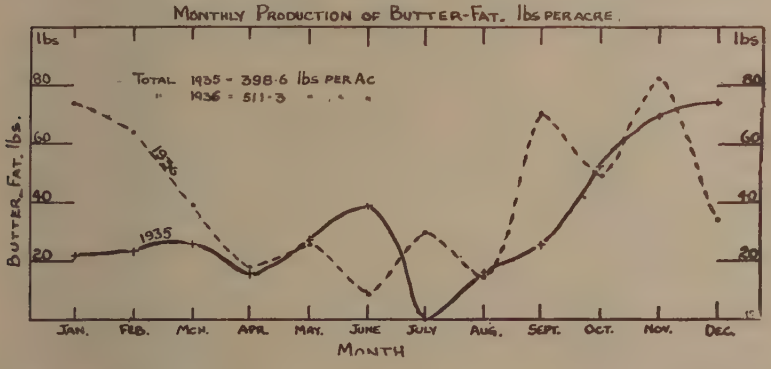
Year.	Grazing Hours.	Total Grazing Days.	Grazing Days per Acre.	Acres per Cow.
1935	38,372·8	4,796·6	371·2	0·973
1936	55,019·2	6,877·4	496·1	0·736

It will be seen that the whole area had a high carrying capacity. In 1935 it was just under 1 acre per cow and in 1936 just under ¾ acre per cow.

Butter Fat Production.

Graph 2 gives the average monthly production of butter fat obtained per acre.

Graph 2.



The above graph shows that for 1936 a very high production of butter fat was obtained for the months of January, February, March, September, October, and November. During these months 40 lbs. butter fat and over were obtained per acre. The production of butter fat was maintained during every month of the year, whereas in 1935 no production was obtained during July.

Excessive or overgrazing the pasture any month during the period April to July has a decided retarding effect on growth and production the following month. This can be seen from the graph which shows high grazing during June, 1935, and the lack of grazing for July. The pasture was slightly overgrazed during May and July, 1936, and shows a corresponding depression in production for June and August. The rapid decrease in production for December was due to the dry late spring and lack of irrigation in November.

Butter Fat Production Per Plot.

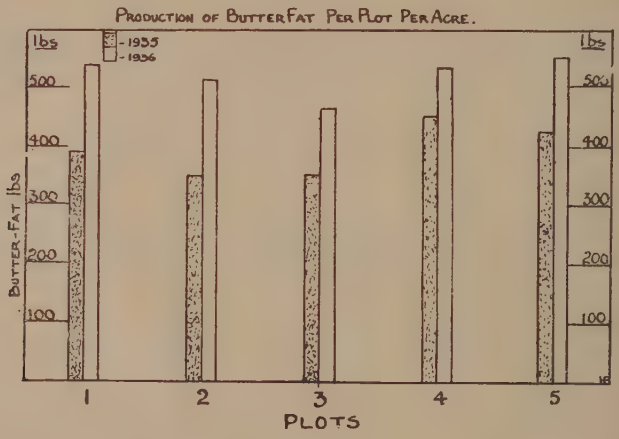
Graph 3 shows the production of butter fat per plot per acre for 1935 and 1936.

It will be noted from the above graph that Plot 3 gave the lowest production per acre for 1936. The effect of the heavy cover crop of Japanese millet during the summer of 1935 is still showing, as the pasture is still more open and showing a higher percentage of couch grass (*Cynodon dactylon*), the establishment of which was favoured by the cover crop.

Plot 5, which had no cover crop or the addition of Ryegrass, when utilised for the feeding of dairy stock, gave the highest production of butter fat per acre. This pasture is now approximately 60 per cent. paspalum and 40 per cent. white clover, an ideal mixture. All plots except 3 gave over 500 lbs. butter fat per acre, Plot 5 giving 550 lbs., and Plot 3 giving 462 lbs. per acre.

Plot 4, which contains approximately 8 per cent. perennial ryegrass in the paspalum-white clover mixture, has given outstanding results for both years.

Graph 3.



Botanical Analyses.

Botanical analyses have been carried out at monthly intervals on the plots from June, 1935.

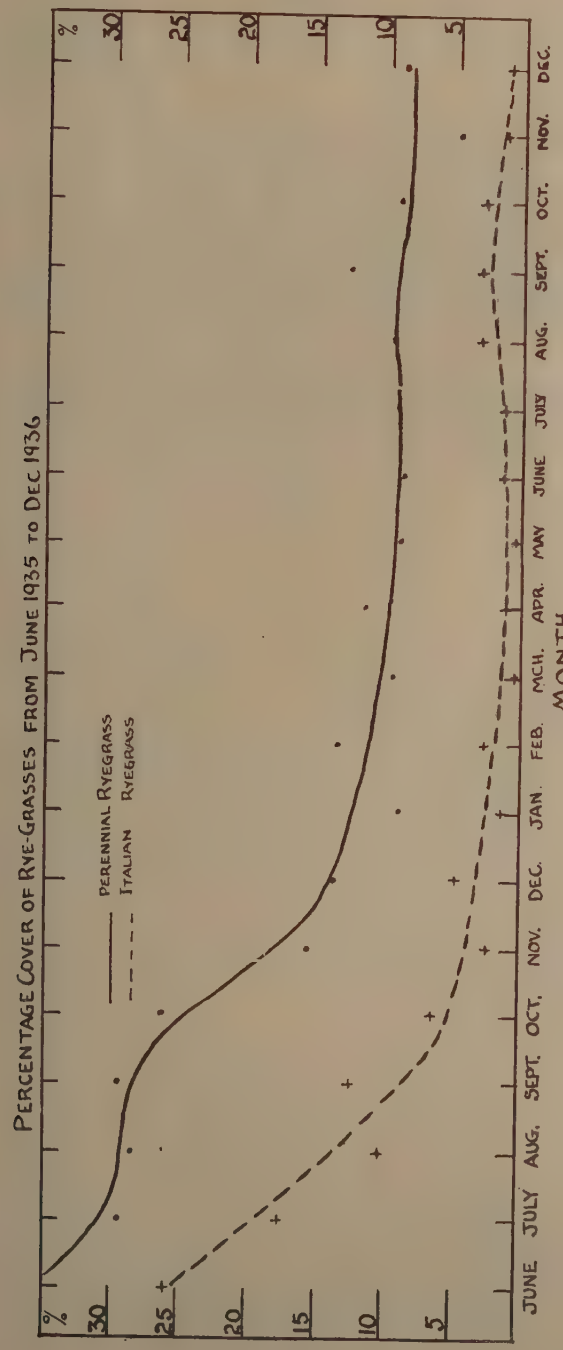
Graph 4 shows the percentage cover of Ryegrass from June, 1935, to December, 1936.

From the above graph it will be seen that the percentage of Italian Ryegrass dropped from 26 per cent. in June to 4 per cent. in December, 1935. Since that date it has gradually declined until December, 1936, when there was only about 1 per cent. in the pasture. From the grazing obtained it shows that it was not economical to add Italian Ryegrass to a Paspalum-White Clover pasture in the existing circumstances under irrigation.

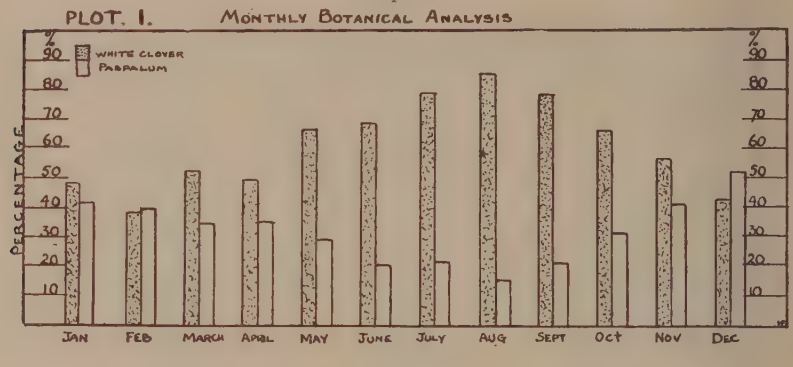
The Perennial Ryegrass showed a steady decline from 37 per cent. in June to 13 per cent. in December, 1935; since that date it has remained fairly constant, having about 8 per cent. cover in December, 1936. From the grazing and production obtained, however, it is considered an advantage to add from 2 to 4 lbs. of Perennial Ryegrass to the Paspalum-White Clover pasture at the time of seeding. It is considered that higher rates of seeding of Ryegrass has a detrimental effect on the initial establishment of White Clover.

Graphs 5 to 9 show the percentage monthly cover of Paspalum and White Clover for the plots 1 to 5.

Graph 4.

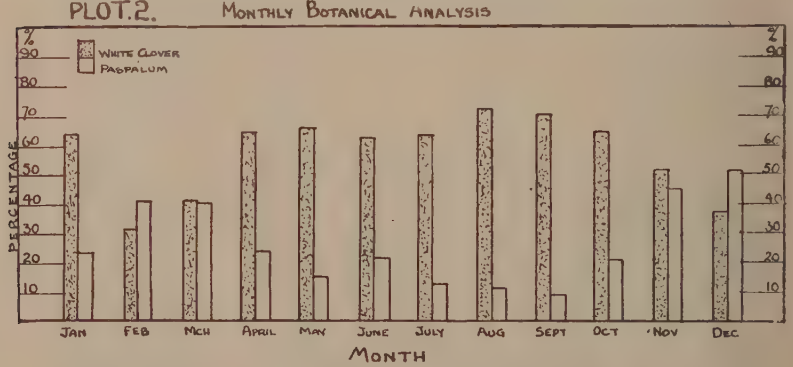

PERCENTAGE COVER OF RYE-GRASSES FROM JUNE 1935 TO DEC 1936
PERENNIAL RYEGRASS
ITALIAN RYEGRASS
%
30
25
20
15
10
5
JUNE JULY AUG. SEPT. OCT. NOV. DEC. JAN. FEB. MCH. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
MONTH

Graph 5.



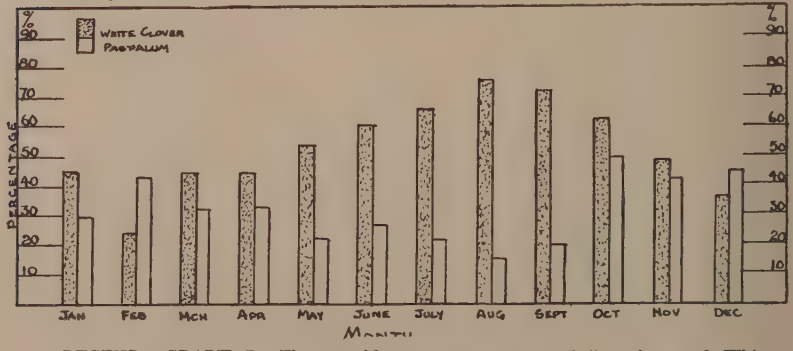
LEGEND. GRAPH 5.—This Graph shows the monthly percentage cover of Paspalum and White Clover for Plot 1. During the earlier part of the season Couch Grass was prominent, being 10 per cent. in January. This has now dropped to less than 5 per cent., being replaced by the more vigorous Paspalum. Throughout the year a full ground cover was maintained and, with the exception of rushes in the irrigation furrows, no weeds were recorded.

Graph 6.



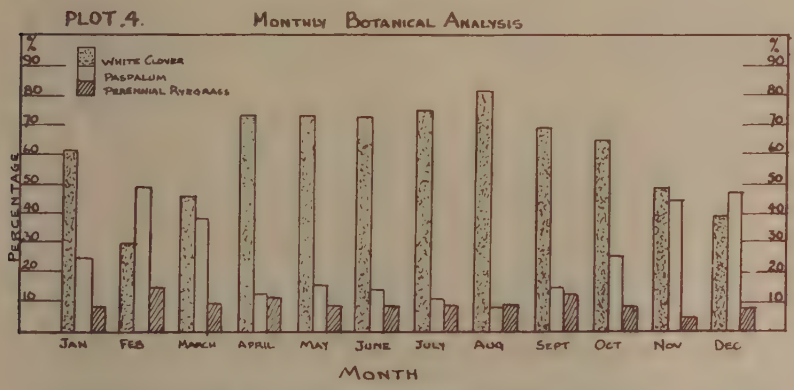
LEGEND. GRAPH 6.—As for Graph 5 the monthly percentage of cover of Paspalum and White Clover for Plot 2 is shown. The cover of Italian Ryegrass is given in Graph 4. A full ground cover for the year was maintained. The amount of Couch Grass present is in the vicinity of 8 per cent. during the hotter months. No weeds were recorded.

Graph 7.



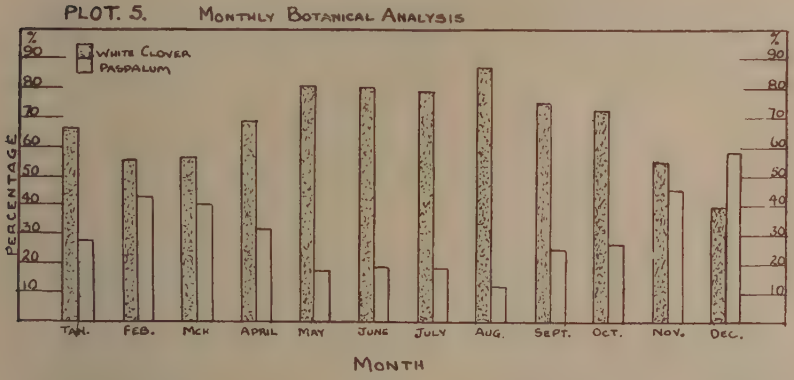
LEGEND. GRAPH 7.—The monthly percentage cover of Paspalum and White Clover is given for Plot 3. Owing to the effects of the heavy cover crop of Japanese Millet at the time of establishment, Couch Grass is more prominent in this plot, ranging from 3 per cent. to 22 per cent. according to the seasons. Some bare ground was recorded during the year. This pasture has a tendency to be more open than the others.

Graph 8.



LEGEND. GRAPH 8.—This Graph shows the monthly percentage of Paspalum, Perennial Ryegrass, and White Clover for Plot 4. For nearly every month of the year a full ground cover was maintained. No weeds were recorded for the year, and Couch Grass never exceeded 4 per cent. cover throughout the year.

Graph 9.



LEGEND. GRAPH 9.—The monthly percentage of Paspalum and White Clover cover is given for Plot 5. No weeds were recorded on this plot, and the percentage Couch cover was practically negligible. This plot is an outstanding Paspalum-White Clover pasture and has maintained a full ground cover throughout the year.

From the above graphs will be seen the percentage of cover of Paspalum and White Clover for all months of the year. It is evident that, during the advent of the cold wet months, the Paspalum is practically dormant and that the White Clover gives the bulk of the feed obtainable, but, with the advent of the warm weather, the paspalum becomes vigorous and tends to dominate the pasture. It is interesting to note the alteration of the Paspalum-White Clover rates during the different seasons of the year.

In Plot 3 it will be noticed that the percentage cover of Paspalum and White Clover is on the average lower than for the other plots. The loss of cover in this plot is due to the heavy cover crop of Japanese millet during the establishment. All plots were showing practically 100 per cent. cover in December, 1936. Couch grass was the only other species recorded in the analyses.

The irrigation channels and furrows are showing a percentage of rush present; these are being controlled by mowing and hoeing.

Tentative Conclusions.

Results show that—

1. Rapid growing cover crops are detrimental on the establishment of white clover and, to a much lesser degree, paspalum.
2. Rapid growing cover crops cannot be recommended when establishing permanent pastures under irrigation.
3. Rates of fertiliser up to 6 cwts. per acre are profitable, and at least 4 cwts. should be applied annually in 3 or 4 applications.
4. Super. and ammonia mixtures are only recommended as an initial application at the time of planting; 2 cwts. at least should be applied.
5. The following seed mixtures can be recommended for irrigation areas:

1.	Paspalum dilatatum	10 lbs.
	White Clover	2 lbs.
2.	Perennial Ryegrass	4-5 lbs.
	Paspalum dilatatum	8 lbs.
	White Clover	2 lbs.

Variety trials now being conducted may result in a variation of the above mixtures, but definite information is not yet available.

RESULTS OF IRRIGATED SPECIES TRIALS UNDER CONTROLLED METHODS OF GRAZING.

The State Committee of the Australian Dairy Council during 1935 made further funds available to be used for initiating demonstrations under irrigation conditions with a view to showing the value of various grass species under controlled grazing.

The State Committee decided as in the case of the initial experiment to co-operate with the Department of Agriculture in establishing two further experimental areas on the properties of Messrs. J. Neil, Waroona, and C. H. Henning, Hamel.

J. Neil's Property, Waroona.

The area when taken over in August, 1935, was mainly under Subterranean Clover and Couch Grass (*Cynodon dactylon*) but had a very heavy infestation of Guildford Grass (*Romulea rosea*) and also Dodder (*Cuscuta spp.*).

12.94 acres of land were selected and ploughing was commenced immediately with a mouldboard plough. This was completed at the end of August.

Cultivation.—The land was first ploughed to a depth of four inches and allowed to remain in fallow for four weeks. It was then cross ploughed during the end of September and thoroughly cultivated so as to prepare a well worked solid seed bed.

The sowing of the seed of all species was carried out during the middle of October, 1935, and lightly rolled in.

The area of 12.94 acres was divided into five fields and a race. The area of the fields is as follows: Plots Nos. 1, 2, 4 and 5, 2.39 acres each, and Plot No. 3, 2.5 acres.

The objects of the experiment include:—

1. To determine the most suitable plants for the establishment of permanent pastures under irrigation conditions on the soil type selected in this irrigation area;
2. The collection of data regarding the carrying capacity of these pastures on small irrigated areas;
3. To determine the actual yields per acre from the various mixtures under existing conditions.

Soil.—The soil consists of a greyish sandy loam overlying a yellowish clay, situated on the plains three miles west of Waroona. The area had a tendency to become waterlogged in the winter and showed evidence of salt during the summer. The original timber was redgum and jarrah and numerous blackboys. During the early winter of 1936, the area was efficiently drained, but owing to the softness of the land no grazing was carried out on the plots during the months of May and July, 1936.

Seed Mixtures.—Seed mixtures sown during mid-October were as follow:—

Plot 1.—New Zealand Certified Mother Strain Perennial Rye Grass, 8 lbs., plus New Zealand Certified White Clover, 2 lbs. per acre.

Plot 2.—New South Wales Handshaken *Paspalum dilatatum* 10 lbs., plus New Zealand Certified White Clover, 2 lbs. per acre.

Plot 3.—New South Wales Handshaken *Paspalum dilatatum* 8 lbs., New Zealand Certified Mother Strain Perennial Rye Grass 4 lbs., plus New Zealand Certified White Clover 2 lbs. per acre.

Plot 4.—New Zealand Tall Fescue 8 lbs., plus New Zealand Certified White Clover 2 lbs.

Plot 5.—Certified *Phalaris tuberosa* 4 lbs. per acre, plus New Zealand Certified White Clover 2 lbs. per acre.

Fertiliser.—Two cwts. of superphosphate and ammonia No. 3 manure per acre were applied at the time of planting, followed by a further dressing of 170 lbs. per acre of the same fertiliser early in March. At the end of April 300 lbs. of superphosphate was applied per acre. This was followed by another application of 300 lbs. of superphosphate per acre early in September, 1936. The total weight of super for the first year was 900 lbs. and 100 lbs. of sulphate of ammonia per acre.

Cultivation.—The whole area was double lapped with Sunblade pasture harrows in August. This greatly facilitated the control of Dodder. A further harrowing was carried out about six weeks later.

Germination and Irrigation.

Generally the germination of all species was good, but soon after germination a week of strong east winds prevailed which dried the surface rapidly, and it was feared at first that reseeding might be necessary. Further irrigations, however, of which there were four during the summer period, have shown that reseeding was not necessary. The water used for irrigation was supplied free by the Irrigation Commission.

Grazing.—The following table shows the grazing days per acre which were obtained per month on each plot:—

Month.	Cow Grazing Days (8 hours) per Acre.					Average Grazing Days per Acre per Month.
	Plot 1.	Plot 2.	Plot 3.	Plot 4.	Plot 5.	
January ...	...	...	...	...	...	...
February ...	13·4	13·4	12·8	13·4	...	10·60
March ...	...	...	...	...	13·4	2·68
April ...	26·0	13·0	12·8	13·0	13·0	15·36
May ...	...	...	...	...	...	...
June ...	14·6	14·6	28·0	29·3	14·6	20·22
July ...	...	...	...	...	...	...
August ...	...	17·6	33·6	17·6	17·6	17·28
September ...	35·1	17·6	...	17·6	17·6	17·58
October ...	30·1	48·4	32·6	48·4	64·2	44·74
November ...	18·8	36·0	16·7	18·0	18·8	21·66
December ...	38·5	38·5	54·8	57·4	76·2	53·08
Total ...	176·5	199·1	191·3	214·7	235·4	203·20
Average ...	14·7	16·6	15·9	18·9	19·6	16·93

Carrying capacity of whole area = 1 cow to 1·303 acres.

Total Grazing:—

1,9534 grazing hours from 12·06 acres
1,619·7 grazing hours per acre
202·46 grazing days of eight hours each per acre, or 1 cow to 1·303 acres.

It will be seen from the above table that Plot 5, *Phalaris tuberosa* and white clover, gave the highest grazing days per acre.

The various mixtures gave the following results:—

Plot 1. Perennial Rye and White Clover = 176·5 grazing days per acre.
Plot 2. Paspalum and White Clover = 199·1 „ „ „
Plot 3. Perennial Rye, Paspalum and White Clover = 191·3 grazing days per acre.
Plot 4. Tall Fescue and White Clover = 214·7 grazing days per acre.
Plot 5. *Phalaris tuberosa* and White Clover = 235·4 grazing days per acre.

Condition of Plots.

Plot 1: During the year there was a good growth of perennial ryegrass, but the cover of white clover was very light in places. Towards the latter part of the season the white clover was showing better growth and covering the bare ground.

Plot 2: This plot produced a very good stand of white clover and during the latter part of the season showed a decided thickening up of the paspalum. The initial establishment of paspalum was seriously affected by the strong easterly winds which occurred after early germination.

Plot 3: This plot contained a considerable proportion of couch grass (*Cynodon dactylon*). The white clover, however, produced excellent growth but the ryegrass and paspalum are taking a considerable time to thicken up.

Plot 4: Both the tall fescue and white clover are growing vigorously and have matted the surface well. The fescue was particularly vigorous during the winter months; although a coarse grass, it was relished by the cows.

Plot 5: An excellent germination of the phalaris and white clover was obtained and both species are growing vigorously, producing the most grazing for the first season.

General.

The white clover was affected during the winter months with dodder (*Cuscuta spp.*), but as soon as the land was firm enough to use the blade harrows, excellent control was obtained. Following the harrows the plots were heavily grazed and harrowed a second time.

During the latter part of the season excessive salt on the surface burnt back a considerable number of the White Clover plants; these, however, revived after the first watering.

In order to arrange for a supply of water in each field, a dam of approximately 200 cubic yards was excavated in a central position and connected to the various fields by a race. This dam can be filled each month during the summer if necessary from irrigation water.

This dam is regarded as a demonstration to the district, as it is generally considered that this type of land will not hold water; however, up to date it has been quite successful.

C. H. Henning's Property, Hamel.

This area was also taken over in August, 1935. It had been under a summer crop of potatoes; prior to that it was under pasture consisting mainly of Subterranean Clover, Drooping Flowered Clover, Paspalum, and Couch Grass.

Ten acres of land was selected. This was divided into five plots of two acres each, with a central race connecting the paddocks.

In this case Mr. Henning supplied all the labour, fencing, etc., and the Australian Dairy Council made available sufficient money to obtain the seed and fertiliser for the experiment. The work was carried out under the supervision of officers of the Department of Agriculture.

Cultivation.

The land was ploughed to a depth of 6 inches during October, left for two weeks, and then worked down and rolled to consolidate the seed bed. Seeding was carried out after irrigation early in November.

The objects of the experiment were the same as that with J. Neil's, Waroona.

Soil.

The soil consists of a deep chocolate loam which was not efficiently drained. The original timber was bluegums. Owing to the lack of efficient consolidation of the soil it was too soft during the winter months to allow of grazing by the dairy stock.

Seed Mixtures.

The seed mixtures sown during November were as follows:—

Plot 1. –New Zealand Certified Mother Strain Perennial Ryegrass 8 lbs., and New Zealand Certified White Clover 2 lbs. per acre.

Plot 2. New Zealand Certified Akaroa Cocksfoot 10 lbs., plus 2 lbs. New Zealand Certified White Clover per acre.

Plot 3.– Certified *Phalaris tuberosa* 4 lbs., plus New Zealand Certified White Clover 2 lbs. per acre.

Plot 4.—New Zealand Tall Fescue 8 lbs., plus New Zealand Certified White Clover 2 lbs. per acre.

Plot 5.—This was not sown, but during early part of 1937 will be seeded to Paspalum and White Clover.

Fertiliser.

An application of 2 cwts. per acre of super and ammonia No. 3 was given at the time the seed was planted. No further application of fertiliser was made until November when 2 cwts. of superphosphate were applied per acre.

Germination and Irrigation.

The germination of the seed on all plots was exceptionally good, and grazing was commenced in February, 1936. Watering was carried out four times during the summer at approximately monthly intervals. Here again the water used was supplied free of charge by the Irrigation Commission.

Grazing.

The following table shows the grazing days per acre which were obtained per month on each plot:—

Month.	Cow Grazing Days (8 hours) per Acre.				Average Grazing Days per Month.
	Plot 1.	Plot 2.	Plot 3.	Plot 4.	
January ...	...	...	...	...	...
February ...	6·9	6·9	6·9	10·3	7·75
March	6·9	3·4	3·4	9·4	5·78
April	15·8	19·7	19·7	19·4	18·72
May	11·8	7·5	3·9	11·4	8·65
June	...	...	...	...	...
July	...	...	...	...	...
August ...	...	...	...	...	...
September ...	...	...	...	...	...
October ...	52·0	42·5	38·0	53·0	46·38
November ...	79·0	...	66·0	151·5	74·13
December ...	48·2	125·7	58·0	125·7	89·40
Total ...	220·6	205·7	195·9	381·0	250·8
Average ...	18·4	17·14	16·33	31·75	20·9

Carrying capacity of whole area = 1 cow to 1·458 acres.
Total Grazing:—
16,047 grazing hours from 8 acres.
2,006 grazing hours per acre.
250·8 grazing days per acre, or 1 cow to 1·458 acres.

From the above table it will be seen that no grazing was obtained for the four months June to September inclusive. This was due to the extreme softness of the ground during the wet months.

The various mixtures gave the following results:—

Plot 1. Perennial Rye and White Clover = 18·4 grazing days per month.
Plot 2. Cocksfoot and White Clover = 17·14 grazing days per month.
Plot 3. *Phalaris tuberosa* and White Clover = 16·33 grazing days per month.
Plot 4. Tall Fescue and White Clover = 31·75 grazing days per month.

To date on this class of country under irrigation the tall fescue has given the highest grazing yields for the first season.

Condition of the Plots.

Plot 1: Generally the ryegrass has not shown a completely thrifty condition but the clover has made a good cover. Couch grass is well established and has mitigated against the successful establishment of the pasture plants.

Plot 2: Here the white clover has made a rapid establishment, but the cocksfoot, although a good germination was obtained, has as yet not thickened up sufficiently to make a good sward. Here again the couch grass has had a retarding effect on rapid establishment.

Plot 3: Excellent germination of both species was obtained, but generally the growth has been poor on account of the lack of efficient fertiliser during the wet months of the year. After topdressing, and with the event of the hot weather, better growth was obtained.

Plot 4: Both the tall fescue and white clover have made excellent growth during the season, the fescue growing exceptionally well during the winter months. Couch grass had also made considerable growth during the season, but was being checked to a considerable extent by the white clover and grazing towards the end of the year.

General.

As was the case on the property of J. Neil, dodder affected the growth of the white clover on Plots 1 and 4. Heavy grazing of these plots during October checked the flowering and seeding considerably. Further drainage on all plots during August assisted in relieving the surplus surface water.

Acknowledgment is made to Mr. C. Giles, Dairy Instructor at Harvey, for collecting the bulk of the field data given in this article.

PIGS—BREEDING AND MANAGEMENT.

(*CONCLUDED.*)

G. K. Baron-Hay, Superintendent of Dairying.

ADMINISTRATION OF MEDICINE.

The pig is an awkward animal to drench and is a bad patient, apparently having no resistance to disease.. The animal, if a large one, should be backed into a corner where a good post is available. A noose should be slipped over the upper jaw, well back towards the corners of the mouth and slightly elevated by passing the cord over the post. The jaws can be kept open with a piece of wood about 1 inch in diameter. Pour the drench into the back part of the mouth through a drenching horn. A glass bottle should not be used. The head should be immediately lowered if there is any sign of movement, otherwise the fluid may pass on to the lungs and cause pneumonia.

Hernia (*Rupture*).

In this condition, some organ or portion of the bowels is released from its own cavity in the abdomen. Generally, a portion of the intestines passes through a rent in the muscles of the body and forms a pouch beneath the skin. This affection occurs in young pigs and is traceable to hereditary predisposition. On being subjected to pressure, there is a peculiar gurgling sound due to the air in the imprisoned part of the intestines. If the animal is rolled on its back, the swollen portion can be reduced by pressing the escaped part back into its natural position. Such animals should be fattened and sold for slaughter. An attempt at cure is not worth while, as these animals should never be used for breeding.

Sore Teats.

This condition is sometimes found in sows a week or so after farrowing, and is usually caused by the sharp tusks of the piglets. If due to this cause, the sow will spring up when bitten and chase the suckers away. If this occurs, the suckers' mouths should be examined for tusks and, if excessively developed, they can be nipped off with a pair of pincers.

The teats should be smeared two or three times a day with Borax and Glycerine, and cleansed with warm water once a day.

Swine Plague or Contagious Pneumonia.

A contagious pneumonia caused by a germ infection. Mortality mostly occurs amongst young pigs. Conveyed to the litter by the sow, which has become affected and recovered, and also by soil contamination with the causal organism.

Symptoms.

Pigs exhibit a loss of appetite and lie about in sheltered places. Deaths occur in several days whilst a few animals recover. In cases which eventually recover the course of the disease is prolonged. In acute cases respiration becomes rapid and shallow—a condition commonly referred to by the farmer as "pants" or "thumps." As the disease progresses the cough becomes more marked and a sticky discharge runs from the nose and eyes.

Treatment.

No treatment is effective.

Control.

Avoid buying pigs which show any indication of the above symptoms and particularly coughers. Should an outbreak occur this disease can be controlled by hygienic precautions—

(a) All healthy pigs should be removed from those showing signs of a cough.

(b) All sick pigs should be destroyed and burnt, or buried deeply.

(c) Pigs should be allowed ample yard space and placed in paddocks if possible.

(d) The removal of sties on to new ground.

(e) Pigs confined for fattening should be placed on an impervious floor.

(f) Feeding troughs should be arranged in order to prevent soil contamination.

(g) Farrowing pens should be provided with impervious floors and thoroughly disinfected before use.

Tuberculosis.

The chief source of infection of pigs is milk from tubercular cows. The disease is slow in its progress, and pronounced symptoms such as would attract the attention of the average pig-raiser are not present. Young pigs succumb to the disease more quickly, and the symptoms are more easily recognised. Such pigs are quickly affected when reared in dirty areas, sties, and yards, with forced feeding and an insanitary environment. If the early stages are not noticed, diseased pigs become infective centres, their foecal discharges being mixed with food in the feeding troughs and yards.

Owing to the bright sunny conditions under which pigs can be reared in Western Australia, the incidence of this disease is low, very few cases of generalised tuberculosis being known, and, where a number of pigs from the same farm are affected, the disease is followed up and necessary steps taken to eradicate it.

Symptoms.

Suckers exhibit symptoms of the disease very quickly. They lose their freshness, become stunted, unthrifty, and the skin appears crusty. Diarrhoea or scours commence and sometimes vomiting. Weaned pigs may exhibit similar conditions.

In older pigs the symptoms are not so definite. Suspicion would be aroused by a daily loss of weight, capricious appetite and general appearance of wasting. A persistent dry cough invariably points to infection, and the glands of the neck may be enlarged.

Treatment.

No remedy is of any value at any stage of the disease. The quicker the animal is killed and the carcase burnt, the less the risk of infecting the health of the herd.

If a number of animals are affected, the yards should be vacated, treated with disinfectant such as lysol or lime, and not used again for at least six months.

Constipation.

This condition may exist in pigs of any age and particularly in the sow before farrowing. It may be a symptom of another disease, but should be treated as constipation as soon as the condition is noted, that is, the dung becomes hard and small and there is a straining to defecate. The condition is quite common where pigs are being fed large quantities of skim milk or butter milk, owing to the curdling of the protein or curd in the stomach.

Treatment.

The pigs should be made to take ample exercise by having to travel for their feed. Ample water should be available and a laxative ration provided, such as green fodder and sloppy food. Bran is of particular value in this connection.

A wine glass full of good quality castor oil should be given to a pig weighing 100 lb. and more in proportion to the weight. If this fails to react within a few hours, then 3 to 4 ounces of Epsom salts dissolved in warm water should be given for each 100 lb. live weight. These purgatives are best given early in the morning before feeding.

Diarrhoea (Scours).

The liability to diarrhoea is much greater in young than in older pigs and is invariably due to faulty feeding. Close damp quarters or bleak wet weather with insufficient protection and warmth may cause scours. Troughs should be kept clean.

In young pigs the discharges are watery, grey or yellow in colour, with a very disagreeable odour. The animals rapidly become weak and stunted, and the tail droops. The coat is staring and rough. The pigs squeal as if in pain. Young pigs soon succumb to this condition.

In older pigs the administering of a wine glass full of good castor oil and removal to clean quarters are usually effective, the food given being light

and easily digested and in the form of a swill. Bran in skim milk is excellent for this purpose. In addition, ½ pint of lime water should be included in the slop each time the animals are fed.

Where a sow is being treated, the same precautions regarding feeding should be taken. She should be given a wine glass full of good castor oil in skim milk. Each sucker should be given one grain of Calomel followed by ½ teaspoonful of castor oil.

Lice (*Haematopinus suis*).

This blood-sucking louse, which is well known to pig breeders, is the largest, most irritating and voracious of all animal lice. At the extreme forward end of this brownish-grey parasite is a piercing stylet and sucking apparatus by which the louse penetrates the skin and sucks the blood. It multiplies by eggs (nits), oval in shape, which stick to the pig's hair by means of a glutinous substance. The favourite place for the louse is in the grooves or folds of the skin behind the ears, or on the inner surface of the hind legs where the skin is thin.

Symptoms.

The animals will be noted scratching themselves, rubbing against posts and other surfaces. The lice and nits are detected easily on inspection. If not dealt with, the pigs begin to lose condition and the consequent irritation brings on various forms of skin disease.

Treatment.

Treatment consists of: Firstly, destroying the lice; secondly, dealing with the nits; and, lastly, cleansing the sties and sheds.

Where large numbers of pigs are assembled, the cheapest method probably is to have a wallow available, which is filled with water on to which a little crude oil or kerosene has been poured.

With small numbers, however, animals can be sprayed or smeared with any vegetable or animal oil, or with a kerosene emulsion prepared as follows:—

Soft soap, 1 lb. dissolved in 1 gallon of water and allowed to boil. When boiling, pour in 2 gallons of kerosene and stir occasionally until the mixture is cool. Add 1 gallon of this mixture to 8 gallons of water and spray or wash the animals.

The nits are destroyed by an application of the kerosene emulsion before being diluted, but this must be applied in the evening, otherwise the heat of the sun will cause scalding.

The sties should be cleaned by disinfection with lysol or phenyle and lime wash, and all old litter, bedding and droppings burnt.

Worms.

The presence of worms in a herd of pigs means daily loss to the owner, and few herds escape infestation. Prevention is the best cure, and well fed pigs kept under clean and sanitary conditions are rarely infested.

Infection occurs through the eggs being swallowed in the feed and, if in sufficient numbers, they form masses in the bowels and may be noted in the excreta.

The most obvious symptoms are that growth is retarded, the animal is restless, the coat becomes stary and rough, the head droops, the back is dished, and there are symptoms of a short cough. The pig is often seen rubbing its hind-quarters at a post or wall.

There are a number of varieties of worms which infect pigs, but the treatment is the same. The most common is the round worm (*Ascaris suilla*), which is about 7 to 11 inches long. This does not suck the blood of the pig, but takes up the food in the intestines, the pig therefore suffering by starvation.

Treatment.

No food should be given for 24 hours, except water. One to 4 teaspoonfuls of turpentine may be given in milk, according to the size of the pig.

Another useful mixture is oil of Chenopodium (2 ounces) with castor oil (16 ounces). Give each pig up to 2 tablespoonfuls of this mixture, according to the size of the animal.

A third remedy is to give up to 1 drachm of Calomel in the food, according to the size of the pig.

Little difficulty will be found in inducing the pigs to take these medicines, provided they have been starved for 24 hours.

USEFUL INFORMATION.

Description of Pigs.

Suckers, Weaners, and Slips.—Young pigs from a few weeks old to those able to leave the mothers to be fattened.

Porkers.—Good to prime conditioned pigs, weighing from 50lbs. to 80lbs. (dressed). Suitable for cutting up into pork.

Baconers.—Good to prime conditioned pigs weighing from 110lbs. to 130lbs. (dressed). Suitable for making bacon.

Stores.—All pigs in low condition, suitable for fattening for market.

Backfatters.—Heavy pigs, fat, and weighing upwards of 180lbs. (dressed). Suitable for sausage manufacturing and ship's stores.

Choppers.—Any pigs of rough and inferior quality, weighing (dressed) over 180lbs.

Table 9.

READY RECKONER FOR PRICES OF FEEDING STUFFS.

Per ton.	Per cwt.	Per lb.
£ s. d.	s. d.	d.
4 13 4	4 8	½
7 0 0	7 0	¾
9 6 8	9 4	1
11 13 4	11 8	1¼
14 0 0	14 0	1½
16 6 8	16 4	1¾
18 13 4	18 8	2

Table 10.

LIVE WEIGHT AT VARIOUS AGES.

Age.	No. of Pigs.	Live Weight. lbs.	Age.	No. of Pigs.	Live Weight. lbs.
1 day	...	...	17 weeks ...	521	71·6
1 week ...	635	3·0	18 „ ...	520	77·5
2 weeks ...	654	5·5	19 „ ...	509	86·8
3 „ ...	654	8·5	20 „ ...	514	93·1
4 „ ...	639	10·9	21 „ ...	504	103·1
5 „ ...	623	13·5	22 „ ...	509	109·3
6 „ ...	592	16·0	23 „ ...	507	118·3
7 „ ...	565	18·9	24 „ ...	507	127·9
8 „ ...	532	25·9	25 „ ...	503	136·8
9 „ ...	518	29·4	26 „ ...	502	145·9
10 „ ...	537	33·4	27 „ ...	487	155·8
11 „ ...	531	37·0	28 „ ...	479	165·5
12 „ ...	531	41·4	29 „ ...	464	173·6
13 „ ...	506	49·2	30 „ ...	452	181·0
14 „ ...	515	51·6	31 „ ...	445	192·9
15 „ ...	518	57·6	32 „ ...	387	199·9
16 „ ...	521	65·1			

The data in Table 10 should be used as a guide to what may be expected under average commercial conditions, as all pigs passing through the feeding trials at the Harper Adams College, England, except obvious "wasters," are included.

BREEDING TABLE.

Time of Service.	Sows—112 Days.	Cows—283 Days.
January 1	April 22	October 10
" 8	" 29	" 17
" 15	May 6	" 24
" 22	" 13	" 31
" 29	" 20	November 7
February 5	" 27	" 14
" 12	June 3	" 21
" 19	" 10	" 28
" 26	" 17	December 5
March 5	" 24	" 12
" 12	July 1	" 19
" 19	" 8	" 26
" 26	" 15	January 2
April 2	" 22	" 9
" 9	" 29	" 16
" 16	August 5	" 23
" 23	" 12	" 30
" 30	" 19	February 6
May 7	" 26	" 13
" 14	September 2	" 20
" 21	" 9	" 27
" 28	" 16	March 6
June 4	" 23	" 13
" 11	" 30	" 20
" 18	October 7	" 27
" 25	" 14	April 3
July 2	" 21	" 10
" 9	" 28	" 17
" 16	November 4	" 24
" 23	" 11	May 1
" 30	" 18	" 8
August 6	" 25	" 15
" 13	December 2	" 22
" 20	" 9	" 29
" 27	" 16	June 5
September 3	" 23	" 12
" 10	" 30	" 19
" 17	January 6	" 26
" 24	" 13	July 3
October 1	" 20	" 10
" 8	" 27	" 17
" 15	February 3	" 24
" 22	" 10	" 31
" 29	" 17	August 7
November 5	" 24	" 14
" 12	March 3	" 21
" 19	" 10	" 28
" 26	" 17	September 4
December 3	" 24	" 11
" 10	" 31	" 18
" 17	April 7	" 25
" 24	" 14	October 2
" 31	" 21	" 9

WARNINGS FROM THE WHEAT AREAS OF NEW SOUTH WALES.

By L. J. H. Teakle, Department of Agriculture.

An important portion of the wheatgrowing areas in New South Wales falls in a zone which is comparable with the Great Southern or the Midland line in Western Australia. The annual rainfall is heavier, ranging from 20 to 23 inches, but a considerable proportion, approximately half, falls in the summer period, so it is probably not more effective for wheatgrowing than the 15-inch—17-inch annual rainfall, which is recorded in these districts of Western Australia. The country is of rolling topography, the principal vegetation consists of eucalypts, and the soils are generally red brown in colour, further points of similarity with the districts referred to in Western Australia. From the soil point of view, they are referred to appropriately as red brown earths in both States.

As in Western Australia, these districts of New South Wales, which may be typically represented by centres such as Cowra and Wagga Wagga, are eminently suited to mixed farming; but at the present time wheat is probably of major importance. Furthermore, in New South Wales, the country will grow lucerne very satisfactorily and offers considerable opportunities for the raising of fat lambs and mixed farming generally.

The farmers of these areas, particularly in the Wagga-Junee section, are faced with two very important problems. The one which has forced itself to the fore in recent years is that of skeleton weed (*Chondrilla juncea*), which has spread very rapidly over some of the best wheat-farming lands. It interferes very seriously with the wheat crop as a weed, and during harvest time interferes with the machinery as it forms a tangled mass in the crop. In fact it has become so severe on some farms that land usually carrying 30-bushel crops of wheat has been virtually abandoned as far as wheat production is concerned.

The skeleton weed resembles milk thistle in some respects. It commences its growth as a small rosette, like other members of the flat weed type, and then sends up flowering stems which are characterised by very few leaves and which carry yellow flowers somewhat similar to those of milk thistle. The barenes of the stems accounts for the name skeleton weed. On maturation, the flowers form a number of seeds which are readily adapted to dispersal by wind acton. Unlike the milk thistle, skeleton weed is a hardy perennial and very quickly establishes a deep root system in which is stored a large quantity of food materials. Thus it is very difficult to control by cultural methods, as the reserves in the root system allow fresh leaves to be sent up regularly after the destruction of the surface growth by means of cultivating implements. A more detailed description of the weed is given by C. A. Gardner in this Journal, Vol. 12, p. 92, 1935.

At the Wagga Experiment Farm, some patches infested by skeleton weed have been cultivated every fortnight for some months. While a high degree of control has been obtained by this method, some plants were still sending up new leaves during the month of February.

Chemical control by the use of poisons appears to be relatively ineffective as well as very expensive and control by cultural methods involves great difficulty and expense. Fortunately it has been found that lucerne will check this weed owing to its more vigorous growth and the only method of control which at present seems at all practical under New South Wales conditions, is the sowing of

lucerne and the maintenance of that crop in a vigorous condition for some years. (See Fig. 1.) This will mean almost complete re-organisation of farming practice in parts badly affected and will force farmers to pay greater attention to the production of fat lambs and other stock.

EXPLANATION OF PLATE.

A, Habit, showing rooting system and bases of the branches. B, Typical leaf, showing the lyrate-runcinate outline. C, Branchlet, showing stem-leaves and flower-heads. D, A flower-head or capitulum, showing the two types of bracts (enlarged). E, Floret, showing the 5-toothed ligulate corolla, and the silky-hairy pappus of the undeveloped achene (enlarged). F, A typical achene, showing the slender beak surmounted by the hairy pappus. G, An achene much enlarged, showing the ribbed exterior, and the roughed upper portion with the calyx-like 5-lobed cup at the apex. Only the base of the beak is shown.

Botanic Gardens, Sydney. Icon. origin.

Skeleton weed has not yet made its entry into Western Australia, but a careful watch should be maintained, particularly where seeds have been obtained from the Eastern States. As it grows in the winter as well as in the summer, it would probably be very difficult to control in Western Australia, as lucerne does not generally grow very vigorously in most parts of our wheat areas which would be suitable for the growth of skeleton weed. Should any suspicious plants be observed anywhere, they should be forwarded to the Department of Agriculture for identification, so that earliest steps can be taken to eliminate this dangerous weed from our agricultural areas.

Fig. 1. Photo. showing the effect of lucerne in practically eliminating the growth of skeleton weed in the Wagga district. The New South Wales Department of Agriculture arranged for this field, which was affected by skeleton weed, to be thoroughly cultivated and sown down to lucerne. A small strip in front of the hay stack was left uncultivated and was not sown. It will be seen that the lucerne has established quite satisfactorily and that, in the uncultivated, unsown strip, the skeleton weed has continued to make vigorous growth. Close exhmination of the lucerne showed the effect in depressing, almost to the point of elimination, the growth of the skeleton weed.

The second problem, perhaps less spectacular than the skeleton weed, but none the less important, is that of soil erosion. Continual cultivation of the rolling country on the western slopes of New South Wales has promoted the washing of the soil in the form both of gullies and of sheet erosion, that is, the removal of the surface soil by sheets of water flowing over it.

So concerned were the agriculturists in New South Wales that an officer of the Department of Agriculture was sent to America to obtain first hand information concerning the problem and means of control in that country, and now the results of his findings are being put into practice in an endeavour to arrest the loss occasioned from soil erosion.

Soil erosion is best controlled by means of a surface cover of growing plants, but in arable land this is impossible during part of the year and under these conditions other measures must be adopted. The contour drain method

has proved useful in New South Wales and is being adopted on the Wagga and Cowra Experiment Farms and by many farmers in the area. Wide, shallow drains are arranged to restrict the surface run-off of water and are put in at intervals of about six feet vertical distance. In order to carry the water away without causing further washing or silting up, the drains are arranged to have a fall of about one foot in one hundred. Where the country is sandy a steeper fall is necessary and about 18 inches in 100 feet is recommended. On heavier soils as little as 6 inches in 100 feet may be adequate. The contour drains are arranged to conduct water to some terminal drain and the excess water carried away.

The main object, however, in the control of soil erosion is to promote the absorption of the surface water by the soil and the restriction of surface run-off, and proper contour cultivation as far as possible is used to this end.

The contour drains are broad and shallow and are generally made by means of a disc plough travelling at a fairly high speed. Sometimes a ditcher is used to facilitate the preparation. Farmers in the hilly districts of Western Australia should be interested in the progress which their Eastern States colleagues are making, and it is certain that in many parts of this State somewhat similar action could well be taken. Farmers may obtain advice and assistance from officers of the Department of Agriculture in the designing of contour drains and other measures to control the soil erosion problem. The matter is of great importance, as it must be realised that once the surface soil has been removed, it is very difficult to get the best returns from working the land.

EGGS.

HOW TO FORWARD THEM TO STORES AND MARKETS.

G. D. SHAW,
Poultry Adviser, Department of Agriculture.

Constant increase of local consumption and the export of every possible egg during our period of high production are now recognised as the only means of assisting the poultry industry, and it is the poultry farmer alone who can make possible that increase. Throughout all egg producing countries the low consumption of eggs and other products can be traced to no other source than neglect by the farmer in the marketing of his products attractively.

Western Australia is slightly ahead of some other Australian States where marketing of eggs is concerned in that legislation is in force which is tending to educate the farmers in forwarding to market and other places of distribution, eggs which must conform to definite standards of quality.

The main clause in our Act which has direct bearing on both local and export marketing is that which defines a clean egg. It reads:—"No person shall pack any eggs intended for sale which are not clean. For the purpose of this regulation 'clean eggs' means eggs which are free from dirt or foreign matter or stains."

Our main aim will be to instruct first and then penalise those producers and others who will not carry out that definite interpretation in the regulations quoted above.

The poultry industry cannot be hampered by those careless producers who will not take the trouble to forward clean eggs to market. No sympathy can be offered when anyone is guilty of marketing dirty eggs. Our intentions are definitely to stabilise an industry which has enormous possibilities, and that industry cannot

be hampered by those who keep a few fowls for home use and market the surplus eggs as and when they accumulate, in numbers sufficient to make the marketing of them worth while.

Eggs must be marketed in a spotlessly clean condition and up to grade and quality. To that end all consigners must:—

1. Collect eggs twice daily.
2. Clean eggs when collected. Do not wait until the egg has lost its natural heat.
3. Market as often as possible.

1. It is of little use collecting eggs twice daily unless care has been taken to have the nesting material clean. Do not use red sawdust—dry material free from odours is the only preventive of dirty eggs. Do not have nests in the sun or where they can get wet. The approach to a nest should be over dry litter or dry ground. Use clean shell grit as a material for nesting.

2. Filth allowed to adhere to an egg for any length of time stains the shell and a stained egg is not a clean egg. Filth will penetrate the shell and set up a deleterious action inside, so clean the egg as soon as it is collected. It saves time and eggs—eggs mean money. *Don't use sand-soap and like materials*—a damp rag only is all that is necessary, but if more drastic methods are needed, look to the cause and remedy it. Drastic methods of cleaning will not only cause a lowering in quality when eggs arrive at the markets, but such lowering of quality, since your case has been branded, means a regrading, and regrading will mean at least 2d. per dozen expense to you on all eggs in that consignment.

3. Do not wait a week or a fortnight in order to obtain sufficient eggs to send to market. Send them as soon as transport is available. Quality is desired and any delay in forwarding lowers the quality with disastrous results. Pack in fillers or clean straw. No dirty material is tolerated.

Those eggs consigned to stores (country and metropolitan) will also be examined for defects whenever it is possible.

It is no credit to have your eggs condemned as dirty when it is so easily remedied.

Clean shell grit in the nests is the best means of keeping an egg clean. If the grit gets soiled it is easy to throw it out into the rain.

The country stores must repack your eggs and clean them also if they are to keep free from condemnation, and that means a cost which is naturally passed on to the producers by the giving of a lower price.

Last, but most important, keep the male birds away from the layers. An infertile egg never goes bad, but a fertile egg must turn, and when it turns it naturally turns everybody with whom it comes in contact.

The fertile egg is the danger to a good name. Let us examine why.

When the male bird is allowed to run with a pen of hens, he naturally fertilises the eggs laid by those hens. When it is realised that 80 degrees of heat will start the germ on its three weeks' journey, we see how dangerous the fertile egg becomes during the spring and summer months.

When the fertile egg is laid and the day temperature is over 80 degrees, the heat applied to the egg starts incubation, and incubation means that the egg should be kept at an even temperature thereafter of 103 degrees for three weeks. During the first night the temperature of the egg room drops to 50 degrees or thereabouts, and so because the egg has not been subjected to 103 degrees almost within 12 hours, the germ dies for want of warmth. Perhaps next day it is very hot, say, 90 to 100 degrees; well, we all know what happens to our butcher's meat when the hot weather occurs, and it is not consumed quickly—it goes bad; so does the egg. In about three to five days of heat such as we experience in summer, the egg has the horrible practice of making itself felt in no uncertain manner.

Unfortunately it is by now in the hands of the consumer, and goes bad in the kitchen. The consumer then "goes off" eggs, and the only person to blame is the producer who will keep the male birds in the hen pens.

Separate the sexes of the poultry farm, and separate them to such a distance that there is no attraction for either sex. Many a hen flies a fence to the male pen, and then flies back to its own yard to feed. It is never noticed until the eggs go bad, and then we are prepared to suggest that those bad eggs never came from our farm because we have the cockerels penned by themselves. If a cockerel flies he is usually found in with the hens; he never goes back to his own yard to feed. The visiting hen is a trouble on farms that even do have separate yards for each sex.

An infertile egg never goes bad.

Even in winter a fertile egg will go bad, because the right heat of 103 degrees is never applied, and the germ dies because it goes stale or weak; but in this case the egg takes a long while, say four weeks, before it begins to turn. Generally speaking, by four weeks the eggs have been consumed with relish as, without heat, there has been no development.

The sexes must be kept apart if you are to guarantee your product, and the guaranteed infertile egg is always the best and will command the best price. The infertile egg gains the confidence of the consumer, and as such the price must lift and the industry go ahead with regard to local consumption.

Summary.

Collect twice daily.
Clean immediately with a damp rag.
Market as often as possible.
Use clean shell grit as a nesting material.
Use clean chaff as a packing material.
Keep the sexes apart except during the breeding season.
Do not market a fertile egg—it is dangerous.
Take a pride in your product. Those who do so will be sure to reap the benefit of that extra care applied.

ERRATA.

THE OFFICIAL AUSTRALIAN PURE BRED DAIRY CATTLE PRODUCTION RECORDING SCHEME.

The following results were inadvertently omitted from the list published in the "Agricultural Journal," September, 1936:—

WILLOW GLEN KATOOMBA.

Breed, A.I.S.; Herd Book No. 6731; Date of birth, 26/4/31; Date of calving 12/11/34; Class, Senior 3-year-old.

Production.—6,276 lbs. milk; average test, 4.76%; butter fat, 298.96 lbs.; sire, Berry Morning Star, owned by A. Della, Esq.

COST OF FEEDING COWS UNDER THE AUSTRALIAN OFFICIAL PURE BREEDS' HERD-RECORDING SCHEME, WESTERN AUSTRALIA, 1935-36.

Published in "Journal of Agriculture, December, 1936.

Line 1 in Table V., p. 463, should read:—

1 S.W. Jersey 387.15 6090 £20 3 3 £2 10 9 £22 14 0 £6 11 9 £16 2 3 4.08.

THE SOWING OF PASTURE SEEDS.

G. K. Baron-Hay, Superintendent of Dairying.
H. G. Elliott, Agricultural Adviser.

During recent months a considerable and growing interest has been exhibited by farmers in the possibilities of improving the quality of pasture on various types of soil. This has led to numerous inquiries being received by the Department, particularly requesting information regarding the types of soil suitable for the growing of different strains of pasture plants and the rates of seeding recommended for these varieties. It, therefore, is hoped that the following notes setting out briefly the preparation of the soil required for the sowing of pasture seeds, and also the types of plants recommended for varying districts, will serve as a guide to those farmers desiring to improve or resow portions of their land to pasture.

Preparation of the Soil.—Whatever the type of soil to be planted, it is essential, in order to secure good germination, that the surface soil be of a fine tilth and that beneath this surface layer, which should be shallow, say, $^3/_4$ of an inch, the seed bed should be well consolidated.

Where mixtures containing perennial grasses are included, it is requisite that the soil should be fertile, and it therefore is undesirable, as a rule, to sow these types of pasture plants on virgin soil.

The land to be planted should be fallowed in spring, cultivation being carried out during the summer months to consolidate and also to destroy germinated weeds. Where the soil is poorly drained, ploughing should be carried out in narrow lands.

The growing of a crop of potatoes or maize during the previous summer may obviate the leaving of the land fallow, and has the effect also of enriching the soil, as these crops usually receive a heavy dressing of fertiliser containing nitrogen. Some form of summer cultivation such as that indicated above is necessary, so that the seeds may be planted and germinate early in autumn while the soil is still warm, without fear of competition from weed seeds.

Irrigated land may be freed from weeds by watering which will germinate these, and a cultivation to destroy the weeds after their germination.

Fertilisers.—Phosphatic fertilisers are essential and, on fertile ground containing a good supply of humus or organic manure, 2 cwts. of superphosphate are recommended. Where the pasture mixture contains permanent grasses, however, and there is some doubt as to the fertility of the soil, a fertiliser containing superphosphate 5 parts to 1 part nitrogen is recommended, such as superphosphate and ammonia No. 2 at the rate of 2 cwts. per acre.

Depth of Seeding.—Pasture seeds should not be sown at a greater depth than ¾ of an inch, or less than ¼ of an inch. If the land is moist to the surface, broadcasting may be practised, followed by a light rolling. A guide in depth of sowing is that "seeds should not be sown deeper than a distance equal to four times their diameter."

Method of Seeding.—Drilling is preferred, and has the advantage of giving a better and more even germination. The seed may be mixed with the fertiliser, but mixing should not take place until it is desired to sow.

Should the seed bed be firm, broadcasting the seed and fertiliser, followed by a light brush harrowing, has given good results.

Time of Seeding.—Autumn planting is the general rule. Spring planting is only recommended where sufficient moisture is present to insure germination, or irrigation water is available.

Quality of Seed.—A great deal of attention has been paid in recent months to the differences found between strains of the same species of pasture plants. Where possible, seeds should be purchased carrying a certificate from some reputable authority, preferably a Government institution, setting out the strain, percentage of germination, freedom from disease and weed seeds. Should the seed purchased be of a low germinating capacity or a non-persistent strain, the total outlay of preparation may be wasted, or, worse still, a direct injury ensue from the harmful nature of weeds introduced.

Rate of Seeding.—The rate of application of pasture seeds per acre varies considerably from district to district, owing to the large area of the State deemed suitable for the growth of some species of pasture plants. The amount of seed to be sown when endeavouring to establish pasture depends on several factors, as follows:—

1. Type of soil.
2. The variety and quality of seed.
3. The condition of the seed bed.
4. The seed mixture to be sown.
5. The climatic conditions governing the district in question.

In all instances, however, the aim in pasture production is to cover the surface of the land with an even sward of fodder as quickly as possible.

The following tables set out the rates of seeding recommended per acre under varying conditions:—

"A."—Where pure stands of any particular variety are to be sown without a cover crop.

"B."—For the sowing of pure stands of a particular variety with a cover crop.

"C."—The sowing of pasture mixtures under various conditions.

"A."—Pure stands without Cover Crop.—Table 1 sets out the rate of seeding recommended for single plant pastures in the three main districts of the State identified by rainfall:—

TABLE 1.

Rates of Seeding for Single Plant Pastures.

Seed.	South and South-West—25–60in. Rainfall.	Great Southern—18–25in. Rainfall.	Wheat Belt—18in. Rainfall.
	lbs. per acre.	lbs. per acre.	lbs. per acre.
Wimmera Rye Grass	8–10	4–6	2–4
Italian Rye Grass	8–10	4–6	...
Perennial Rye Grass	8–10	...	...
Cocksfoot	8–10	...	...
Phalaris tuberosa	2–4	3	...
Timothy	4–6	...	...
Subterranean Clover	2–6	4	4
Drooping Flowered Clover (scarified seed)	1–3	1–3	...
Cluster Clover	...	4	3–4
White Clover	2–4	...	...
Red Clover	4–6	...	...
Lucerne	8–15	5–9	2–3
Lotus major	4	...	...
Burr medic	8–12	8–10	6–8
Lupins	1–1½ bus.	1 bus.	½–1 bus.

"B."—Pure stands with a Cover Crop.—In many districts the practice of establishing pasture in two years by the use of a cover crop is quite common. The advantage of this method is that less seed per acre of the pasture plants is required, as these plants will thicken during the second year by seeding, only annual pasture plants being generally used.

Table 2 gives the rate of seeding where such pure stands are required following a cover crop, usually a cereal:—

Table 2.

Seeds Sown with a Cover Crop.

Seed.	South and South-West.	Great Southern.	Wheat Belt
	per acre.	per acre.	per acre.
Wimmera Rye Grass and Oats	5 lb. 1½ bush.	1 to 3 lb. 1 bush.	½ to 1½ lb. 1 bush.
Wimmera Rye Grass and Wheat	5 lb. 1 bush.	2 lb. 45 to 60 lb.	½ to 1 lb. 45 lb.
Subterranean Clover and Oats	2 lb. 1 to 2 bush.	2 lb. 1 to 1½ bush.	1 to 2 lb. 1 bush.
Crimson Clover and Barley	4 lb. 1 to 1½ bush.	3 to 4 lb. 1 bush.	... ...
Lupins and Wheat	... ...	6 to 10 lb. 45 to 60 lb.	2 to 4 lb. 45 lb.

"C."—Pasture Mixtures.—These are usually sown in the heavier rainfall districts of the State, and any mixture should contain tall strong-growing high fertility grasses with a proportion (approximately 40 per cent.) of legumes. The particular mixture decided upon is governed mainly by the type of soil available and the prevailing climatic conditions.

To assist in deciding upon the mixture to be sown, Table 3 sets out the various types of soil commonly met with in the South-West portion of the State on which it is desired to establish permanent pasture.

Table 3.

Soil Types for the Sowing of Pastures in the South-West.

A.—Well-drained undulating country omitting gravel hills, *i.e.*—
(1) with over 40 inches rainfall, *i.e.*, Denmark, Manjimup, Margaret River;
(2) with 30-40 inches rainfall, *i.e.*, Donnybrook, Bridgetown.

B.—Coastal plain type: Clay loam to a heavy clay carrying red gum, flooded gum, generally requires draining, *i.e.*, Benger, Cookernup, etc.

C.—Summer moist land excluding drained peaty swamp, including certain portions of Napier Creek country.

D.—Drained peaty swamps.

E.—Sandy to sandy loam waterlogged in winter, often carrying peppermint, stunted jarrah, etc., *i.e.*, low country around Busselton.

F.—Same as "E," but with clay subsoil, *i.e.*, 4-8 inches.

G.—Dry, more or less gravelly ridges.

Mixtures Recommended.—The various mixtures recommended under different conditions, and for the various types of soil indicated in Table 3 above, are concisely grouped in Table 4 according to whether the land to be sown is—

(a) Virgin land.

(b) Old cultivated non-irrigable land ("dry").

(c) Irrigated land.

In sowing these pasture mixtures, particular attention should be paid to the fertility of the soil and reference made to a paragraph on "fertilisers" earlier in this article.

TABLE 4.

Seed Mixtures for Various Soil Types—Pounds per acre.

Virgin Land—Autumn Sowing.

A1.—Italian rye grass 4-6 lbs.
Subterranean clover 2-4 lbs.
White clover (certified) 1 lb.

A2.—Italian rye grass 4-6 lbs.
Subterranean clover 2-4 lbs.

B.—Italian or wimmera rye grass 4-6 lbs.
Subterranean clover 2-4 lbs.
Drooping flowered clover (scarified seed) 1 lb.

C.—Spring or early autumn seeding:
Paspalum dilatatum 10 lbs.
White clover (certified) 1 lb.
Lotus major 1 lb.

*D.—*Paspalum dilatatum* 10 lbs.
White clover (certified) 1 lb.
Lotus major 1 lb.

E.—Drooping flowered clover (scarified seed) 2 lbs.
Yorkshire fog 2 lbs.

F.—Subterranean clover 2 lbs.
Drooping flowered clover (scarified seed) 2 lbs.

*Kikuyu planted at 3 ft. intervals can be substituted for paspalum.

Old Cultivated Land—Autumn Sowing.

A1.—Italian rye grass 8 lbs.
Cocksfoot 4 lbs.
Subterranean clover 2 lbs.

A1.—Italian rye grass 4 lbs.
Paspalum 8 lbs.
White clover (certified) 1 lb.
Lotus major 1 lb.

A1.—*Phalaris tuberosa* 3 lbs.
White clover (certified) 1 lb.
Subterranean clover 1 lb

A2.—*Phalaris tuberosa* 3 lbs.
Subterranean clover 2 lbs.

A2.—Italian rye grass 8 lbs.
Subterranean clover 2 lbs.

C.—Perennial rye grass 5 lbs.
Paspalum dilatatum 8 lbs.
White clover (certified) 1 lb.
Lotus major 1 lb.

G.—Wimmera rye grass 5 lbs.
Cluster clover 3 lbs.

Note.—Subterranean clover where recommended only to be added if not already present.

Irrigated Land—Autumn or Spring Sowing.

New Land:
Paspalum dilatatum 10 lbs.
White clover (certified) 2 lbs.
Subterranean clover 2 lbs.

Old Land:

1 *Paspalum dilatatum* 8 lbs.
Perennial rye grass 4-5 lbs.
White clover (certified) 2 lbs.

2. *Paspalum dilatatum* 10 lbs.
White clover (certified) 2 lbs.

3. Perennial rye grass 8 lbs.
White clover (certified) 2 lbs.

4. *Phalaris tuberosa* 4 lbs.
White clover (certified) 2 lbs.

THE "BACTERIOLOGICAL COUNT" OF MILK.

ITS VALUE AND SOME IMPROVEMENTS IN THE TECHNIQUE OF THE DIRECT COUNT METHOD.

By H. Kretchmar, B.Sc., A.A.C.I., F.C.S.

The aims of this paper are:—

A.—to show the value of the bacteriological examination of milk;

B.—to discuss the reasons for selecting the direct count method and to show that, besides other advantages, it can be made of sufficient accuracy for all practical purposes.

A.—The Value of the Bacteriological Examination of Milk.

A good milk must satisfy the following requirements:—

1. Be bacteriologically clean, and especially, free from pathogens, i.e., disease producing organisms.
2. Have a high food value, indicated by—
   (a) high fat content;
   (b) high solids not fat content;
   (c) high vitamine content.
3. Be free from rubbish such as dust, rust, etc.

Methods are available for readily determining whether a milk satisfies the requirements 2(a) and 2(b). Methods for determining 2(c) are available, although they are tedious. Methods of readily estimating physical rubbish are also available. In the following section of this paper, the methods for determining the bacterial content of milk are discussed.

The reasons that milk should be bacteriologically clean are that the presence of bacteria indicates:—

(a) contamination of the milk with undesirable material such as stale milk films on improperly cleaned milking machines, milk containers, etc., or dust and manure, etc. blown in from the yards.

(b) Stale milk, its age being sufficient to allow the few unavoidable initial contaminating organisms to increase to large numbers.

(c) The milk having been kept at too high a temperature.

(d) Contamination from an infected udder.

Thus a high bacteriological count indicates that one or more of the four factors above mentioned has or have been in operation.

Also the bacteriological content of milk has a direct bearing on its keeping quality. For these reasons, therefore, a sound knowledge of the bacteriological content of milk is of paramount importance for controlling the production of high quality milk.

B.—The Reasons for Selecting the "Direct Count" Method.

The chief reason for selecting the direct count method is that it is quite independent of bacterial growth and reproduction. Any method which involves these factors should be excluded as being incapable of giving a sufficiently reliable count because the conditions necessary for growth such as respiratory, temperature and

nutritional requirements are so variable among bacterial species that it is impossible to select any set of conditions which will be suitable for the simultaneous growth of all those species which may be found in milk.

Furthermore the "direct count" is the only method which includes all bacteria, living or dead. Dead organisms are not counted by cultural methods, yet these dead organisms, just as surely as do the living organisms, indicate that undesirable conditions have applied to the milk at some stage of its history.

This method has the advantage also of a less complex technique than other methods and the results are more rapidly available.

The "direct count" appears capable of being brought to such a stage of perfection as to be of great value. In the past it has received insufficient attention, no doubt largely because the "plate count" has been declared by many public bodies in different countries the standard method for the bacteriological grading of milk. The British Medical Council themselves admit (The Bacteriological Grading of Milk, page 383 (6))—

> "The Breed smear method has not received in this country the attention it deserves. It is in the rapid grading of milk that the method finds its greatest value. There is no other test that enables a differentiation between clean and dirty milk to be made so rapidly—within a few minutes—and the test is, therefore, of inestimable service at collecting stations where milk from individual farms is bulked preparatory to dispatch to the large towns in rail or road tanks. The test is of considerable assistance to farm inspectors and agricultural advisers because it so frequently enables a distinction to be drawn between the various faults of production to which any given milk is subject It can be used as a control to the plate count or as a substitute for it."

Again, the value of the method is indicated in the "Standard Methods of Milk Analysis" of the American Public Health Association and the Association of Official Agricultural Chemists, from which the following statement is taken, page 35:—

> "As it is only in this way" (*i.e.*, by the Breed smear method), "that counts of bacteria themselves can be made, it must be recognised that accurately made microscopic counts of individual bacteria give the truest picture of the actual number of bacteria in raw milk that can be obtained with any technique."

The fact that the investigators of the Medical Council did not obtain a good correlation between the farm inspections and the "direct counts" cannot, the writer considers, be used as an argument against the use of the "direct count" as an indicator of satisfactory or unsatisfactory conditions on the farms. The allocation of the marks during the farm inspections was on a purely arbitrary basis. As many detrimental factors for first-class milk production are difficult of detection and any one such factor may easily be of such importance as to completely nullify the effect of all other factors, no such correlation is to be expected. For example, one improperly sterilised can may be such a potent source of bacterial infection as to render valueless all other efforts towards cleanliness, hence the marks obtained for general farm cleanliness might be very high, yet the milk, because of that one source of infection, might be highly contaminated. Furthermore, there was no correlation between any other laboratory tests and such farm inspection marks.

Arising out of the work of milk control which has been carried out in Perth and the Metropolitan Area, without exception, it has been found that unsatisfactory bacterial counts in producers' milk can be correlated with the neglect of one or more of the factors necessary for clean milk production.

C.—The Direct Count Method.

The chief objections which are raised against the "direct count" are the following:—

(a) the difficulty of making a smear the bacterial content of which is representative of the bulk milk;

(b) the difficulty of staining all the bacteria in the smear;

(c) the difficulty of examination;

(d) the lack of accuracy of the method, which is intimately connected with (a) and (b).

It is proposed now to deal with these points in detail, showing where improvements have been effected and to indicate where further work is probably desirable.

Making the Bacterial Smears.

1. The samples are collected as described in detail in Journal Department of Agriculture of W.A., Vol. XI., June, 1934, p. 328 et seq.—Briefly this is as follows:—

A clean, sterile boiler gauge-glass tube of length sufficient to reach to the bottom of a can of milk and plugged at one end is gripped by the plugged end and used to thoroughly stir the contents of the can. It is then allowed to drain for a moment, then slowly lowered vertically through the milk until it reaches the base of the can. The mouth of the tube is then sealed by the thumb of the operator and a column of milk drawn out and carefully allowed to flow into a sterilised wide-mouthed bottle, whose stopper is immediately replaced and secured by means of a special spring clip.

Because of the variation in the size of bottles, etc., it is necessary to check the quantity of milk collected by the tube and the amount held by the sample bottle in order that the bottles shall not be more than two-thirds filled. If filled to a greater extent than this the contents cannot be adequately mixed by shaking preparatory to pipetting out the milk for smearing. The samples are kept in the ice box described in the above journal article. It has been suggested in the literature that samples could be kept by the use of preservatives, formalin generally, but before this change can be introduced, it is necessary to prove that formalin in no way interferes with the staining of any of the bacteria in the milk smears with the particular staining technique employed. Furthermore, once the organisms have been killed by the addition of formalin, the sample can be no longer used for cultural tests for pathogenic bacteria.

2. Ordinary 3in. x 1in. glass slides are used for the smears. These should be 1 mm. $\pm$ 0.05 mm. thick so that refocusing of the light on the slide is not necessary as one changes from slide to slide during the examinations. The slides should be permanently marked at one end with a glass marking diamond. Such a slide conveniently holds four 1sq. cm. smears placed side by side. There is no advantage in having the slides any larger to take more smears because if these are carefully made as will be described it is not possible to make more than four smears and dry them down in less than five minutes from the time of commencing to measure out the first sample. Drying within this time is necessary to prevent bacterial multiplication and the segregation of the fat droplets. On the other hand, the drying must not be accomplished too rapidly or the film will crack. The slides must be perfectly freed from grease and dirt by boiling in a suitable cleaning solution. Before making the smears a slide is dipped in rectified spirits, flamed in the usual way, cooled and placed over a guide plate marked with squares of 1 cm. side. The guide plate should preferably have a black background.

3. The sample is thoroughly mixed by shaking vigorously up and down some fifty times. The four samples may be shaken at the same time. It is possible that cases might arise where this amount of shaking is insufficient to obtain the accuracy required. In such cases it is suggested that the milk be stirred with a small electrically driven stirrer which could be cleaned between samples in the same manner as the pipettes. (See Section 5.)

4. The clips are taken off the bottles and the stoppers loosened. The bottles are lined up on the bench and a note made of their sample numbers against the number of the slide to be used.

5. 0.01 ml. of milk is pipetted out from each bottle, the various drops being placed in order along the length of the slide. Special 0.01 ml. pipettes (Breed pipettes) are necessary for accurate work. It is preferable to use a clean sterile pipette for each sample, but if the same pipette is to be used, it should be thoroughly cleaned before passing from one sample to another by first washing in hot chromic acid solution to destroy organic matter and then rinsing through with water which has been freed of organisms by filtration through a bacteriological filter.

It is interesting at this point to calculate the change in a high-count-milk which could possibly be produced by dilution of the sample with water remaining in the pipette after washing.

From figures given for the calibration of Breed pipettes (to deliver 0.01 ml. of milk they should be calibrated to hold 0.0104 to 0.0105 ml. mercury) it can be seen that the pipettes retain about 5 per cent. as much milk as they deliver. Let it be assumed they retain the same volume of water, which is perfectly mixed with the next sample of milk when it is drawn up.

Volume of water 5/100ths ml., bacterial content nil.

Volume of milk 100/100ths ml., bacterial content say 2,000,000 per ml.

Total volume 105/100ths ml., bacterial content 2,000,000 per 1.05 ml.

Bacterial content of milk delivered = 1,900,000 per ml.

$$\% \text{ error} = \frac{100{,}000 \times 100}{2{,}000{,}000} = 5\%.$$

In other words, the effect of the dilution is negligible. With lower-count milks the error would be even less.

Complete destruction of organic matter is essential after each measurement. It is most difficult to completely remove milk from such small pipettes and avoidance of any carry over of pathogens is essential if incorrect diagnosis of udder infections and incorrect counts are to be avoided.

6. Each drop of milk is spread over an area of 1 sq. cm. of the glass slide by means of a flamed platinum needle. Platinum needles are necessary as scale forms in a thin film on substitutes and flakes off into the smear. In the flaming process the needle is heated red hot, then cooled right down by immersion in rectified spirit, the excess spirit is shaken off and the last trace removed by touching momentarily to the flame. This procedure avoids placing a hot needle in the smear. It is necessary to thoroughly mix the milk in the smears and this is accomplished by a stirring motion as indicated in the following diagram. This method of stirring has been found to produce a sufficiently even distribution of the organisms in the smear for the work of this laboratory.

7. The slide is placed upon a carefully levelled warm plate to dry. The plate must be carefully levelled plate so that the films will be of even thickness when dried own. The following description of the author's warm pate may be helpful.

On a sheet of compressed mica insulating sheet, size 9in. x 5in., are wound 75 turns of 38 B. & S. gauge nichrome wire finishing within ½in. of each end. This heater is placed between two sheets of glass six 9in. x 6in. x ⅛in. thick, with two strips of the insulating material size 9in. x ½in. along each side of it. The plate is finished by a frame made of motor car wind screen framing placed around its edge, and the ends of the winding taken to an electric plug which is screwed to a plate soldered on the frame. To take up any play a piece of cartridge paper is wrapped around the glass under the frame. As the supply voltage is 250 and the resistance of the heater 2,436 ohms, the power consumed is 25 watts. By occasionally switching the current on or off as required, the plate is easily maintained at a suitable temperature.

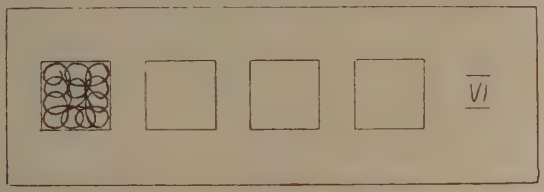


Diagram illustrating the method of stirring the smears.

8. The slides are now placed upon a levelled staining rack and the smears fixed by flooding the slides with pure methyl alcohol and allowing it to remain on them one minute. The alcohol is then drained off and the slides dried, using a clean filter paper for each slide.

9. The slides are next immersed in a staining trough of xylol to remove the fat. They should be left there for two minutes or longer. The xylol is then dried off by means of a clean filter paper, using a separate paper for each slide.

The percentage of the bacteria which is removed with the fat will be negligible. Hammer & Nelson have shown for example (Res. Bull. 137, Iowa Agric. Expt. Stn., p. 115) that if butter is separated into its two phases, aqueous and fatty, by centrifugalisation, that the percentage of organisms accumulated in the fatty phase is 0.01 to 0.04 per cent. of the number accumulated in the aqueous phase. Certainly these figures were arrived at by the use of the agar plate procedure, but they show that the percentage of organisms which might be removed is certainly very small.

10. The slides are again placed upon the staining rack and flooded with rectified spirit (95 per cent. alcohol content). This is allowed to remain there for two or three minutes.

11. The alcohol is drained off and the slides flooded with methylene blue stain.

The stain used in this laboratory is made by dissolving 3 gms. of Grubler's methylene blue in 200 mls. absolute alcohol and just prior to use adding 22 mls. of this stock solution to 75 mls. of distilled water and filtering.

The stain is allowed to act on the smears about 75 seconds.

12. The stain is drained off and the slides flooded with rectified spirit (95 per cent. alcohol content). This alcohol is rapidly drained off and a fresh quantity poured on. The total time required in the spirit is about 2 minutes.

By working carefully, it is possible with a little practice to so arrange the scheme of work that several slides may be stained at once, and each slide will remain for its allotted times in the stain and in the alcohol.

13. The rectified spirit is drained off and the slides flooded with absolute alcohol which is allowed to remain there for 30 seconds to one minute. The alcohol is then drained off and the slides dried, using a clean filter paper for each slide.

The absolute alcohol makes the films appear very clear for examination under the microscope.

Some writers advise rinsing the slides in water after staining, but this spoils the clearness of the film. A slight weakness in the above staining technique is the series of changes from 95 per cent. alcohol to 23 per cent. alcohol and then back to 95 per cent. alcohol. It would almost certainly be an improvement to work out a satisfactory stain dissolved in 90 per cent. or 95 per cent. alcohol, and decrease the first alcohol to about 70 per cent.

The "direct count" has been attacked on the grounds that all the bacteria are not stained sufficiently to be recognised and counted. This may be correct, but it is considered that by the above technique very few fail to stain. If it is shown that any consequential percentage is not stained the method should not be condemned, but the staining technique should be improved. It is most unlikely that a satisfactory technique would not be evolved as the known most difficult organisms to stain, the acid fast group, definitely can be stained in milk smears by the use of suitable methods.

The microscopical examination of the smears:

It may be safely stated that any difficulties and strain experienced in the past with the microscopical examination of milk have been occasioned by a lack of appreciation of the correct technique in using the microscope. That such an appreciation of the correct use of the microscope was in most cases lacking may be shown by reference to one oft-published statement *i.e.*, One is frequently advised to adjust the diameter of the object field exactly to 0.205 mm. diameter by lengthening or shortening the optical tube-length of the microscope as may be found necessary. Microscope makers design their optical equipment for a standard tube-length with a standard cover glass thickness, and any departure from standard cover glass thickness is compensated by a generally slight change in optical tube length. Hence, generally, the optical tube-length necessary to give an object field diameter of 0.205 mm. is not the same length as is necessary to give correct definition over the whole object field. That adequate definition was not obtained over the whole object field is shown by the fact that for precise work it was necessary to use oculars having the central portion of the field marked off by a circle and counting only the bacteria found in that portion.

The following notes may help to assist in choosing and using the optical equipment to be used in the examination of milk smears.

Consider, first, the microscope stand. This should be of heavy construction and capable of inclination of at least 45° from the horizontal. A mechanical stage with vertical and horizontal motions is required but rotation is valueless. A stage capable of enabling the whole surface of a 3 x 1 slide to be examined is sufficiently large. The mount of the substage condenser should be adjustable by rack and pinion and means should be provided for centring the condenser. Adjustment to obtain oblique illumination is valueless. The tube should be fitted with rack and pinion coarse adjustment and any good type of fine adjustment, and should preferably be so spring mounted that the objective cannot be forced through the slide. A revolving nosepiece is not required.

In considering the optical system it is convenient to start with the condenser. An oil-immersion condenser is ruled out because an oil-immersion condenser can only be correctly adjusted when oil immersion of the condenser is used, and in routine work such oil-immersion would cause a too great waste of time and trouble of adjustment. We are thus limited to dry condensers with their consequent maximum working aperture of 1.0. However, with the limitation that it must be a dry condenser the best possible component should be selected, and this requires it to be both achromatic and aplanatic.

The objective may now be chosen. A total magnification of some 700 x or a little greater is sufficient and comfortable to work with. If an objective with a magnification of about 70x is chosen (*i.e.*, focal length about 1/10th in.) and used with an ocular of 10x magnification, we obtain the desirable conditions of a reasonably high total magnification and a fairly high-power ocular. A high-power ocular is desirable because of resultant greater flatness of field. This combination will be found to give an object-field closely approximating 0.205 mm. diameter. (In the case of one maker the object-field was found to be 0.200 mm. diameter.) Now if an objective of magnification 90x (*i.e.*, of focal length about 1/12th in.) had been chosen, the corrections of the system would not have been so good as it would be found necessary to use a low-power ocular of about 4x magnification to obtain the correct diameter field; the resultant magnification would only have been about 360x and the depth of focus would have been less. The writer can find no advantage in using apochromatic objectives instead of fluorite type objectives. The numerical aperture of the condenser should be about 0.9x the numerical aperture of the objective if glare is to be prevented. Now the aperture of the condenser has been fixed at 1.0, so it follows that the aperture of the objective should be

$$1.0 \times \frac{1.0}{0.9} = 1.11 \text{ or greater.}$$

Consistent with keeping the aperture greater than 1.11 it is desirable that the aperture be kept low because increase of aperture means decrease of depth of focus. The advantages of high apertures are greater resolving power and increased light gathering power. A resolving power greater than that given by a lens of numerical aperature 1.2 or 1.3 is not required for this work and the degree of illumination is easily pushed beyond the limits of comfort with any reasonable source of illumination, using a lens of this aperture and with a total magnification of 700x.

Binocular.—For protracted research work or for long periods of routine work a binocular attachment or binocular body is almost a necessity. Various systems, employing similar principles to those illustrated overleaf, are in use.

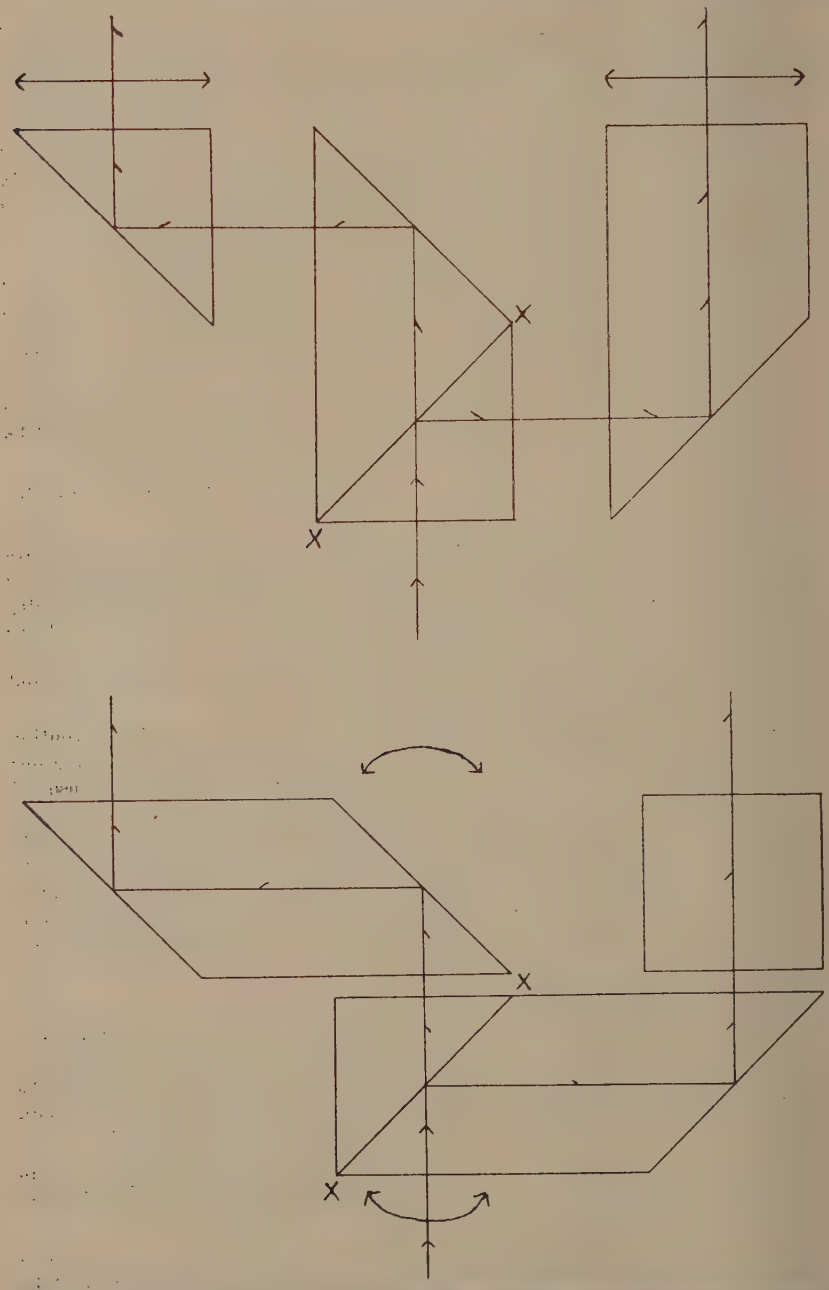
In the upper system interpupilary distance is adjusted by moving the optical elements, as indicated by the arrows, and this alters the optical tube length. It is an undesirable arrangement as optical systems are designed for a definite tube length. In the lower system interpupilary distance is adjusted by rotating the optical elements as shown by the arrows. The optical tube-length is not altered by this adjustment and the system, therefore, is quite satisfactory.

Adjustment of the microscope:

1. The source of illum nation which has been found most satisfactory is a piece of double ground and finely ground glass with a 30 watt concentrated filament motor car headlamp globe placed close behind it. The glass and globe should be suitably mounted in a lamp casing fitted with a slotted carrier immediately in front of the ground glass so that diaphragms may be inserted.

2. A yellow-green colour filter is placed in the microscope substage or in front of the lamp. This, besides optical advantages, makes the light much more restful to the eyes.

3. A correcting achromatic lens is centred immed ately below the condenser to correct for non-parallel rays coming from the lamp. The lamp should be placed at such a distance from the microscope that the length of path traversed by the light rays between the lamp and the correcting lens is equal to the focal length of the lens.



Diagrams illustrating the principles of the optical systems of microscope binocular attachments.

×× is a half-silvered, semi-reflecting surface.

4. A slide is placed on the microscope stage and the mirror adjusted until the field of view is illuminated. Focus the slide and then turn the mirror until the margin of the diaphragm on the source of illumination is seen across the field of view. Rack the condenser up or down until the margin of the diaphragm is accurately focussed on the slide. Recentre the image of the source in the field of view. Change the diaphragm until one is obtained the image of which just coincides with the margin of the field of view. This adjustment lessens glare.

5. If using the monocular microscope the tube length must be adjusted to that length for which the ocular system is calculated.

6. Measure the diameter of the field of view by using as object a slide micrometer. The factor to be used in making the calculations may be derived by remembering that for a field diameter of 0.205 mm. the factor is 300,000, and that the factor is inversely proportional to the square of the radius of the field of view.

The above direct count method for the bacteriological grading of milk has the following merits:—

(a) It is simple to perform.
(b) Little apparatus is required.
(c) It is economical.
(d) Results are rapidly available.
(e) Diagnoses of udder infections may be made simultaneously.
(f) The smears may be kept as permanent records.

It is proposed to show in a subsequent complementary paper representative data illustrating the number of fields which it is necessary to examine to arrive at the most probable count for a smear containing a given number of bacteria, and the degree of accuracy which is obtainable in the counts at various bacterial growth levels.

FIELD EXPERIMENTS, 1936.

CHAPMAN RESEARCH STATION.

G. L. Throssell, Agricultural Adviser.
F. Gishubl, Farm Manager.

The following Field Experiments were conducted at the Chapman Agricultural Research Station during 1936:—

Fallow v. Non-Fallow.
Rate of Seeding (2).
Rate of Superphosphate (2).
Potash-Nitrogen.
Fungicide.

SOIL AND CULTURAL DETAILS.

The land on which the experiments were planted originally carried jam and wattle scrub and the soil on which the Fallow and Non-Fallow, Rate of Seeding (S.H.J.), Potash-Nitrogen, and Fungicide experiments were sown was a red sandy

loam, while the other experiments were planted on soil of a lighter nature. For the past six years a two-years' rotation, fallow and crop, has been followed and prior to that a three-course rotation of fallow, crop and pasture was practised.

With the exception of the Fallow and Non-Fallow experiment the cultural details of all experiments were as follow:—Ploughed with a mouldboard plough to a depth of 4 inches in July, 1935, and cultivated with a springtyne cultivator in September and again in May, 1936, and prior to seeding, which was done with a disc drill.

THE SEASON 1936.

The crop went in under ideal conditions, as the cultivations after the April and May rains effectively controlled the weed growth and a very even germination was obtained. A heavy downpour of nearly three inches of rain which was experienced during the first week in June caused some damage on the slopes through washing, and was responsible for some unevenness. From then on until the end of August very good growing conditions were experienced, and the crops made splendid progress and gave promise of good yields. However, a prolonged dry spell, accompanied by hot dry winds, which lasted throughout the whole of September very adversely affected the crops, and it was indeed fortunate that a good downpour of 94 points of rain fell on 29th and 30th September, and so saved the situation. The following is the rainfall recorded during the year together with the averages for the previous years:—

	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total.
					Growing Period.									
1936	0	3	0	113	149	590	248	264	123	53	1,427	50	0	1,593
Av., 30 years ...	30	41	79	65	240	416	393	280	159	96	1,584	30	26	1,855

RESULTS OF EXPERIMENTS, 1936.

FALLOW AND NON-FALLOW EXPERIMENT.

To ascertain the effect of Winter fallowed land on the Wheat Crop.

The fallowed land was ploughed with a mouldboard plough to a depth of 4 inches in early August, 1935, and springtyne cultivated at the end of both April and May, 1936. The unfallowed land was ploughed with the same implement on 22nd May, 1936, and cultivated a week later.

FALLOW *v.* NON-FALLOW EXPERIMENT.

Planted on 1st June, 1936. Superphosphate—112lbs. per acre. Germinated on 4th June, 1936.
Variety—Nabawa. Seed—60lbs. per acre.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre, 8 yrs.	Percentage Yields, 8 yrs.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Fallow	9 22	13 49	...	...	...	11 36	144	15 21	118
Non-fallow	6 13	9 49	...	...	...	8 2	100	12 58	100

Except for the fact that the unfallowed plots were more weedy than the fallowed plots little difference could be detected in the growth of the plots, owing to the favourable growing conditions. However, when the dry spell was experienced during September the unfallowed plots suffered very much more than the fallowed plots from the lack of moisture.

The results both for this and the previous years are distinctly in favour of fallowing for wheat growing.

RATE OF SEEDING EXPERIMENT.

To determine the most economical rates of seeding for both the free and sparse stooling varieties of Wheat.

For this experiment the free stooling midseason variety Nabawa, and the sparse stooling early variety S.H.J. were used.

RATE OF SEEDING EXPERIMENT.

Planted on 26th May, 1936. Superphosphate—112lbs. per acre. Germinated on 29th May, 1936.
Variety—Nabawa.

Rate of Seed.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre, 12 yrs.	Percentage Yields, 12 yrs.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
60lbs. per acre ...	10 40	10 56	11 28	11 20	11 52	11 15	106	14 4	103
45lbs. per acre ...	10 40	10 24	10 16	10 24	11 12	10 35	100	13 43	100
90lbs. per acre ...	11 28	11 28	13 4	12 48	11 36	12 5	114	15 2	110

Variety—S.H.J.

Rate of Seed.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre, 13 yrs.	Percentage Yields, 13 yrs.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
60lbs. per acre ...	10 42	11 15	11 40	12 47	12 47	11 50	112	16 17	107
45lbs. per acre ...	8 53	9 18	10 58	11 23	12 22	10 35	100	15 15	100
90lbs. per acre ...	10 0	12 55	12 47	13 37	12 55	12 27	118	16 54	111

Both this year's and the previous year's results are in favour of the heavier rates of seeding, both with the sparse and free stooling varieties. At least 60 lbs. and up to 90 lbs. per acre can be applied with profitable results, especially in those years when weeds are bad.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

To ascertain the most economical rates of Superphosphate to apply to the Wheat Crop.

This experiment is divided into two sections:—

(a) Receiving rates of nil. 75 and 150 lbs. of superphosphate per acre.
(b) Receiving rates of 150, 225 and 300 lbs. of superphosphate per acre.

RATE OF SUPERPHOSPHATE EXPERIMENT.

Planted on 25th May, 1936. Variety—Nabawa. Germinated on 28th May, 1936.
Seed—60lbs. per acre.

SECTION A.

Rate of Superphosphate.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre,	Percentage Yields.	Average Yields per acre, 1936.	Percentage Yields, 1936.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Nil	13 37	13 53	15 33	15 58	14 35	14 43	97	11 9	79
150lbs. per acre ...	13 37	14 52	15 0	15 58	16 6	15 6	100	13 39	100
75lbs. per acre ...	14 2	15 17	14 52	16 6	15 50	15 13	101	12 32	92

SECTION B.

Rate of Superphosphate.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre, 8 yrs.	Percentage Yields, 8 yrs.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
300lbs. per acre ...	18 56	18 32	18 8	20 24	20 0	19 12	118	13 52	105
150lbs. per acre ...	15 20	16 0	16 8	16 56	16 48	16 14	100	13 10	100
225lbs. per acre ...	17 20	16 24	16 8	16 56	17 4	16 46	103	13 24	102

The results of both this year's experiments and those of the previous years indicate that the wheat yields are increased by the application of superphosphate, and that under the existing economical conditions, the most economical rate is about 112 lbs. per acre.

POTASH NITROGEN EXPERIMENT.

To ascertain if applications of a nitrogenous fertiliser and a nitrogenous and a potassic fertiliser together, in addition to the usual dressing of superphosphate, are profitable for wheat growing.

POTASH-NITROGEN EXPERIMENT.

Planted on 26th May, 1936. Seed—60lbs. per acre. Variety—Nabawa. Germinated on 30th May, 1936.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
112lbs. Superphosphate; 112lbs. Sulphate of Ammonia	13 28	13 45	15 50	16 6	17 30	15 20	107	13 10	108
112lbs. Superphosphate	13 28	13 37	14 43	14 10	15 33	14 18	100	12 10	100
112lbs. Superphosphate; 112lbs. Sulphate of Ammonia: 56lbs. Sulphate of Potash	13 53	15 25	16 32	17 55	18 20	16 25	115	13 34	111

Increased yields were obtained from the use of a nitrogenous fertiliser and a nitrogenous and a potassic fertiliser, in addition to superphosphate, but the average results show that the increased yields are insufficient to warrant the extra cost incurred by their use.

FUNGICIDE EXPERIMENT.

The object of this experiment is to determine the effect on the growth and yield of the resultant wheat crop when the seed is treated with copper carbonate and an organic mercury compound, as fungicides for Bunt.

For the purpose of this experiment three sets of plots were used, each repeated five times, viz.:—

(1) Seed treated with copper carbonate, 2 ozs. per bushel.

(2) Seed untreated.

(3) Seed treated with an organic mercury compound, 2 ozs. per bushel.

FUNGICIDE EXPERIMENT.

Planted on 28th May, 1936. Superphosphate—112lbs. per acre. Germinated on 4th June, 1936.
Variety—Nabawa. Seed—60lbs. per acre.

Pickled with—	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average *Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre.	Percentage Yields.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Copper carbonate ...	13 3	14 43	15 33	14 35	13 37	14 18	101	...	...
No treatment ...	12 55	14 52	15 25	14 18	13 37	14 13	100	...	...
A mercury compound	13 37	15 0	15 25	14 18	13 28	14 22	101	..	...

*Five replications.

No difference could be detected in the rate of germination or growth of any of the plots throughout the year, and although this is the first year that this experiment has been conducted at this farm, it would appear that the use of these fungicides have no effect upon the yield of the wheat crop, either deleterious or beneficial.

It must be pointed out, however, that in this experiment the seed used was entirely free of spores of Bunt or Ball Smut, and that the experiment was not designed to demonstrate the effectiveness of the two powders as a fungicide, but rather to ascertain if they had any effect upon the growth and yield of the crop itself.

PLANT DISEASES ACT, 1914-1935.

ORCHARDS—ANNUAL REGISTRATION OF.

The Plant Diseases Act requires every owner or occupier of an "orchard" in which one or more fruit trees or one or more fruit vines are growing shall cause such "orchard" to be registered at the Department of Agriculture, St. George's Terrace, Perth.

"Orchards" which are situate within that portion of the State which is north of the 28th parallel of south latitude and is east of the 119th meridian of longitude are exempt, however, from registration.

It is important to realise that it is the "orchard" that is registered and not the person and, therefore, it is essential that the location or full address where the trees or vines are growing should be correctly stated.

The registration of orchards is annual and must be on the prescribed form, and lodged on or before the 1st of July of each year, together with a fee of one shilling (1s.).

Any persons who fail or neglect for one month to register an orchard as required by the Act shall be guilty of an offence.

The penalty provided is £20 and, in addition, a daily penalty of £1 for each day or part of a day during which such default continues.

The Act also provides that "The minimum penalty for any offence shall be one-twentieth of the maximum, and no Court or Magistrate shall have any power to reduce such minimum."

Those persons who did not register "orchards" for the year ended the 30th June, 1936, or have established new orchards since 1st July, 1936, are advised to do so at once as they are now liable to be prosecuted without notice.

Registrations for the year ending June, 1938, are not due until 1st July, 1937, but for the convenience of those who wish to do so, and to obviate the congestion and delay which must necessarily occur when thousands of orchardists leave their registration until the last minute, the Department will now accept applications for registration, and issue certificates for the year ending 30th June, 1938.

Cards of application for registration may be obtained from the Department of Agriculture, St. George's Terrace, Perth, from Police Stations and Clerks of Courts in the metropolitan area (Perth excepted), and at the Stock Departmental Office at Victoria Quay, Fremantle.

In the country towns and districts application should be made to the Clerk of Courts or the Police Officer in Charge.

LUCERNE FOR THE SOUTH-WEST.

M. CULLITY, B.Sc. (Agr.),
Agricultural Adviser.

Lucerne is one of our oldest cultivated crops, having been used by man for more than 2,000 years. It belongs to that family of plants known as the *Leguminosae*, various members of which have been largely used by farmers in the past century in their rotations, they having observed that crops following on legumes seemed to grow much better. They believed this result was due to some peculiarity of legumes, but it was not until the last thirty years that this peculiarity was explained. The association with certain bacteria in the soil enables legumes to draw one of the principal plant foods, not from the soil, but from the air. The plant and bacteria exist together for their mutual benefit in a state of symbiosis, the bacteria living on plant juices or substances drawn from those juices, while at the same time making available to the plant stores of easily assimilable nitrogen which has been drawn from the air, where it exists in enormous quantities in a form useless to the plant. The indication of the presence of these bacteria may be easily seen by examining the root system of a species of this family of plants for small growths known as nodules.

Lucerne, however, does not often figure in an ordinary rotation, so the beneficial effects to crops following it are not often seen. What is more often apparent, however, is the comparatively poor growth of lucerne due to an insufficient number of the lucerne bacteria being present. This can be remedied by the farmer by topdressing the area with a small quantity of soil taken from an area where lucerne is growing strongly. However, it is always better to take the precaution to see that bacteria are present when sowing. This may be done in three different ways—

(1) by topdressing the area to be sown with a quantity of soil as above; or

(2) by mixing the seed to be sown with a few pounds of soil as above, dried, but not heated. (The drying of this soil should be done in a shaded place, as sunlight will kill the organisms. Sowing should then be carried out in the afternoon to prevent the injurious action of the sun); or

(3) pure cultures of the organism may be obtained from the Plant Pathology Branch of the Department of Agriculture at a small charge to cover cost. These are shaken up in skim milk or very thin glue, and the seed mixed with it. It is dried sufficiently for sowing, which, as with the soil dusting method, should be carried out in the afternoon.

Soils.

Lucerne thrives in a variety of soils, and, from the experience in the newer districts in the South-West, it would appear that with attention, payable results may be obtained off almost any soil. The best condition is a deep free-working soil, with free water several feet below ground level, but in the majority of cases where a good permeable subsoil is present, enabling the long roots to penetrate, it will be found that lucerne will thrive. Even in cases where on examination of the subsoil it would appear to be too stiff for roots to penetrate, payable results have been obtained.

One absolute essential to success is drainage, as lucerne will not grow in sour soil. Patches are often seen in lucerne plots where weeds, etc., are prolific, and the lucerne appears to have died out. These on examination usually are depressions where water lies. The benefit of lime to lucerne is often attributed to its sweetening effect rather than any mechanical or manuring effect.

Preparation of Soil.

Lucerne being a deep rooter, it is necessary that the preparation of the soil be to such a depth as to allow the young roots to get as far down as possible in a short time. The depth of ploughing, however, must be controlled by the type of soil. If the soil is only four inches, it would be a mistake to plough six inches and bring a portion of the subsoil to the surface. Weeds are a big problem in establishing a new field, as these will often kill or choke out the young lucerne plants which are slow growers. It is preferable to plough the land some time before it is required to sow, and to destroy the weed growth by frequent cultivation. Where autumn planting is carried out this cannot be done as the germination of the weeds and the lucerne will take place about the same time. To control this, it is necessary to plant the lucerne in drills so that cultivation may be given between the rows. Where possible it is preferable to sow the ground that is to be laid down to lucerne with some clearing crop, oats, etc., but preferably potatoes where it can be done. This crop has the advantage of opening up the soil to a good depth, leaving a large residue of fertiliser behind, and leaving the ground free from weeds.

The land should be worked down to a good seed bed with the disc cultivator or harrows. Often before sowing, a final very shallow ploughing is given, followed by the harrows and the roller to give a fine, firm seed bed. The rolling is necessary, because the lucerne seed being small requires to be well packed in the soil, otherwise malting may occur.

Time of sowing will vary with the conditions. With good moisture-holding soils spring planting is better, as this gives an opportunity of cultivating for weed destruction throughout the autumn and winter. On other locations, however, as on the hillside slopes of Manjimup, for instance, it is often advisable to sow in the early autumn in drills. The lucerne will germinate and make fair growth before the winter sets in. The plants then generally are in an excellent condition for fast growth during the ensuing spring, for as the moisture recedes in the soil the young tap-roots are in a position to be able to follow it down.

On the flats or in the gullies of that district sowing may be held over until the spring, providing the area is worked up early in the autumn, and has been kept clean.

Sowing.

The quantity of seed to sow will vary according to whether the crop is sown in drills or broadcast. Where drilled six to eight lbs. seed will be found sufficient. Where broadcast 12 to 15 lbs. will be required to give a good result. Both methods have their advocates and good results may be obtained by either method.

Where weed growth is bad or summer cultivation is necessary, it will be found that sowing in drills will enable weed control and moisture conservation to be carried out much more easily. However, where the ground is clean and sufficient summer moisture is not a problem, broadcasting is the easier method.

Manuring.

When sowing, a mixed manure of superphosphate and sulphate of ammonia is desirable. The sulphate of ammonia is included, as the young plants will not have sufficient bacteria on their roots to absorb enough nitrogen from the air. A mixture recommended is not less than 224 lbs. superphosphate and 56 lbs. sulphate of ammonia per acre.

As the yields of lucerne when properly established are huge, it is necessary that continuous manuring be resorted to. Not less than 1½cwt. of superphosphate should be applied twice in each year—first in early autumn and the second in early spring. The reason for this manuring is that each cutting of lucerne

may be considered as a separate crop, and when five or six cuttings are made in one year, the necessity for manuring heavier than for the ordinary cereal or pea crop is obvious.

It is particularly beneficial—where the soil selected is suspected of sourness—to apply a dressing of slaked lime at the rate of approximately one ton per acre (half ton quicklime). Where freight charges are high it is preferable to purchase this as quicklime, allowing the lime to air slake before applying. Where liming is to be carried out, it is necessary to arrange the work so that this may be done at least a month before the seed and fertiliser are applied.

After Cultivation.

Following on the germination of the lucerne, the farmer's heart is often saddened by a dense growth of weeds, and as the young lucerne plants are not strong enough to withstand cultivation, he is often at a loss to know what to do. The remedy is easy, it being only necessary to keep the whole growth low by mowing or grazing. Where the mower is available it should be used when the plants are just about six inches high. As this cut is not worth gathering, it is left as a mulch over the surface. Often, however, it is decided that the cheapest and easiest method is to graze the field. This for best results should be done as quickly as possible, and with small stock. Where the field is kept low the weeds are losing in vitality during the whole period while the lucerne roots are getting a stronger and firmer hold, giving the plants an added vitality and enabling them to shoot away from the weeds. The grazing or mowing has an added benefit in causing the lucerne crowns to throw out more stems, or, in other words, to stool out.

As soon as the plants are considered strong enough, which may be decided by pulling at the roots, cultivation should be resorted to. The area should be grazed or mown, and the harrows or cultivator then brought in. Where sown in drills the scuffler may, of course, be used without cutting the crop. As a general rule, it should be remembered that the more cultivation given, the better the yields, one effect of stirring the soil being to allow the air in greater quantities into the ground where the nitrogen may be withdrawn by the nodule bacteria. A good routine for working is to decide on two main cultivations in each year—one in early autumn when the first rains are expected, and the other in early spring or when the winter rains are finishing. Topdressing should be applied at these times. After each cutting a good harrowing is particularly beneficial. These cultivations have a twofold benefit—in the cold weather in allowing more free access of air to the nitrifying bacteria, and in the spring and summer in making a mulch, conserving the moisture necessary for the summer growths.

Harvesting or Time for Cutting for Hay.

Two main indications are to be looked for when deciding when the lucerne crop is ready to be cut for hay.

(1) When the plants begin to flower.
(2) When the crowns begin to throw out new shoots.
(3) In some cases, in cool weather, loss in feeding value and weight occurs before the plants flower; the indication that this is happening is given by the lower leaves turning colour. Good hay should be green, fresh, free from weeds and rubbish, with a good pleasant aroma, and carrying all the leaves.

If hay-cutting is delayed beyond any of the three stages mentioned above, loss will occur by a loss in digestibility. Leaves will drop off more easily in handling, making for a loss of weight. A further consequence to the delay in

cutting is that the succeeding growth will not come away as quickly nor will it yield as well.

The best season for hay-making is during the late spring or summer, as the weather is then suitable for curing. Earlier in the season it will usually be found more profitable to feed green or to graze, as the sappiness of the stalks and the unsettled state of the weather makes the task of hay-making a hazard.

Lucerne "cures" very quickly, so the skill in handling it needs to be higher than that required for ordinary meadow hay. Care should be taken that the drying material is not handled more than strictly necessary during the heat of the day. Raking into windrows and carting to the stack is best done in the morning or late in the afternoon. During the middle of the day the material dries out and becomes extremely brittle, resulting in nearly all the leaf being lost if harshly handled then. In the afternoon when the atmosphere is cooling, moisture is absorbed by the hay, with the result that it can be handled with comparative ease.

It is advisable that the windrows be formed as soon as possible after cutting, allowing the green material time to wilt only. In our climate, as often as not, the hay can be stacked direct from the windrow, but where stacking has to be delayed, it is advisable to form it into large cocks as soon as the plants are dry enough. This may be tested by examining a sample. If, when twisted with the hands, no sap is discernable, it may be concluded that the material is in condition for stacking or placing in large cocks. Care, also, should be exercised that the plants do not get too dry or brittle in the rows.

Yields.

Five cuttings in one year is about the minimum that may be expected from this crop. Each cutting should yield at least 1½ tons of hay, so that the minimum quantity of hay that a plot would yield, if not fed green or grazed, would be approximately seven tons per acre. Mr. G. F. Coombs, of Jardee, between September, 1928, and April, 1929, obtained seven cuttings from his two acres, and, while feeding it green and as hay to his herd of cows during the whole period, finished up with approximately seven tons stacked in his shed.

Life of a Stand.

The length of time during which this crop will produce these quantities of fodder should make every farmer a lucerne grower. Small plots in the Manjimup-Pemberton area have been in existence for over ten years, some of the outstanding successes being those of—J. Prosser, 10 acres; D. Hunter, 6 acres; A. V. Kjellgren, 3 acres.

One paddock in the Denmark area has now been down to lucerne for 20 years. Naturally, after a period of years, the stand becomes a little thinner, and it is sometimes then advisable to plough in for a change of crop for a year or two, and then to reseed.

Grazing.

Where it is intended to graze an area of lucerne great discrimination must be shown, or else considerable damage will be done to the crop. When it is young the roots have not firm enough hold of the ground to withstand the severe tugging and pulling that it would receive from large stock, therefore, while the stand is still young it is advisable to graze only with small stock, and then by putting as many on as possible so as to shorten the time of grazing, and by taking them off before grazing bare has occurred. Where possible, it is advisable to avoid grazing during the first two years. With sheep it is particularly necessary to exercise care in this respect, as these stock can graze very close to the

ground, and as a consequence, if left in the paddock too long, will crop off the crowns of the plants, resulting in the following crops being considerably thinner.

Continuous grazing of lucerne has a particularly bad effect on the crop, and to avoid this, when it is fit for grazing by ordinary stock, it is advisable to put as many on at a time as is possible. This insures that the whole crop will be eaten off even before the young shoots commence to appear on any portion.

Care should be taken when grazing stock on lucerne that they are not let in when it is wet, either by rain or dew, or when they are very hungry. Hoven is likely to be caused by feeding this succulent feed to hungry stock. The danger is greatly increased when the plants are wet. When cattle are being introduced to this crop after a spell away from it, it is much better that they be well fed first so that they will not be able to consume great quantities, or, if this is not possible, to turn them on for thirty minutes and take them off, letting them on again for a similar period a few hours later. They soon become accustomed to the crop, and will be able to remain in the crop without danger. However, it must be said that grazing, whatever its advantages, materially lessens the life of a stand.

It is difficult to understand why farmers, and particularly dairy farmers, in the South-Western districts do not pay more attention to this crop. As a general statement, it may be said that suitable lucerne soil exists on every location. In the group settlement areas a very large number of farmers have small areas, but have room for increase. In Bridgetown, Balingup, Kirup, Donnybrook, etc., practically none is grown, although great benefits would follow its introduction, particularly where the farmer has to milk his cows during the dry months. The provision of green lucerne then will make all the difference in the yield of his stock.

PREVENTIVE AND COMBATIVE MEASURES AGAINST POTATO MOTH (PTHORIMAEA OPERCULELLA),

by

L. J. NEWMAN, F.R.E.S., Government Entomologist.

and

E. T. MORGAN, Officer-in-Charge, Potato Branch.

The potato moth is always present both in the potato fields and in storage sheds, and the damage done by this pest is well known to the majority of potato growers. In dry seasons, such as that which was experienced during the spring of 1936 and in the early part of this year (1937), the damage done by the larvae of this moth has been widespread in the potato growing areas of the South-West. The irrigation areas contribute in no small measure to the big carry over of the pest, as with the growing, or the attempted growing of three crops of potatoes a year, growth is provided to maintain the pest at a maximum throughout the summer months.

Indications point to much trouble in the irrigation areas from Brunswick to Dardanup, as in this zone the main spring crop is normally grown. This crop is harvested in October and November and if dry conditions prevail some moth infestation is observed in the haulms and often in small potatoes left about the land, and these make for an ideal breeding ground. If another crop is planted nearby

in October or November, the growing plants are likely to be affected, and if still another crop is planted in January in the near vicinity a further happy hunting ground is provided for the pest.

Much advice has been disseminated in past years by the Department of Agriculture concerning the potato moth, but the present seems an opportune time once again to bring before growers the need for thorough farm sanitation, if this pest is to be kept in check. Infestation may commence at any time from the planting of the seed to the digging, storage and sale of the tubers. Therefore the selection of the seed, the cultivation of the soil before and during the growth of the crop, remedial means, where infestation exists, and the treatment of the crop after being dug, are matters to especially consider.

Cultivation.

This plays an important part and should be thoroughly carried out, as by this means many of the pupae in the soil are destroyed, and where any crop has been harvested, the tops should be gathered and burnt and the land ploughed. The soil should also be well worked during the growth of the crop to prevent the cracking so frequently seen in heavy soil. It is always in those districts where the soil is of a heavy nature and not thoroughly worked that the pest is most destructive to the tubers.

Seed.

The choice of seed is of main importance, as it is the greatest medium in the dissemination and propagation of the pest. It does not matter how carefully the land has been prepared and cleaned up if the pest is again introduced by the seed, the whole of the previous good work thereby may be undone. It behoves the grower therefore to make every endeavour to keep his seed, as well as ware potatoes, as free of trouble as is humanly possible.

Infestation in the Field.

The pest is very destructive in the field, the grubs mining their way into the leaves of the plants, thereby removing the chlorophyll or green portion, which is so essential to the health of the plants, the attacked leaves having a parchment-like appearance.

As the larvae of the potato moth do not consume the epidermis of the leaves or tubers, when commencing to mine, control is difficult and sprays which are effective against many other leaf-eating insects are not so effective against this pest, and a lead-arsenate spray has not proved satisfactory. It has also failed to prevent infestation in experimental beds when applied at the rate of 1½ ozs. per gallon of water.

The effect of dusting plants with lead arsenate in experimental work has afforded some protection against this miner and the efficiency seems to vary directly with the concentration of the dust up to 75 per cent. but a concentration of 50 per cent. is considered suitable.

A dusting powder that can be recommended, therefore, is composed of 50 per cent. arsenate of lead (powder) and 50 per cent. of sieved air-slaked lime and this should be applied during a calm early morning. Owing to the feeding habits of the larvae or miner as afore-mentioned, the results of dusting are somewhat difficult to explain, but possibly larvae wandering about on dusted leaves are contaminated with the poison, carrying it into the mine and polluting the interior.

Various ovicidal sprays have been tried but there are inherent disadvantages in their use in the field, the chief being the necessity for frequent applications and

the high costs thus involved. Furthermore, there is often such a dense mass of foliage that the thorough wetting of the plants is difficult and so far no thoroughly effective egg destroying spray has been developed.

That the potato moth is attracted to lights has been known for many years, and the use of lamps placed in shallow trays of water, to which a small quantity of kerosene has been added, has been used by a number of growers in the past. Experimental trials have demonstrated that the adult potato moths can be destroyed by light traps, but that they are not effectively attracted to the lights at a distance of more than 1 chain. These lights are also attractive to cut-worm moths.

Storage.

In the storing of *seed* potatoes a thorough dusting of the tubers with a mixture of 50 per cent. of arsenate of lead (powder) and 50 per cent. of sieved slaked lime is recommended, but such a dust should not be used on potatoes intended for eating purposes. Fumigation should be employed in the storage of such tubers.

Fumigation.

Fumigation, as hereinafter advised, has proved entirely effective as a means of destroying all stages of the potato moth in stored tubers, both ware and seed. The fumigant recommended is carbon bi-sulphide. The formula is 2 lbs. per 1,000 cubic feet of space for a period of 48 hours. A single fumigation at this strength for 48 hours does not always suffice to destroy all the eggs or pupae; a second fumigation should therefore be applied six to eight days later in summer, and 12 to 16 days later in winter. The choice of the interval of six to eight days depends on the fact that in the summer the majority of the eggs hatch within this period, and if the application of this second fumigation is longer delayed, then the young larvae from these eggs which survived the first fumigation may do considerable damage to the tuber buds, and those pupae which were not destroyed, in the first treatment would issue as moths and carry on their destructive work.

Fumigation with carbon bi-sulphide at the above strength and period may be safely applied three times without serious injury to the vitality of the tuber-buds, crop yields, or eating qualities.

It is most important to see that the fumigation is done during moderately cool temperatures, say between 75 to 80 degrees Fahrenheit. If done during very hot weather the tubers may be seriously injured, or if temperatures are too low, the chemical does not readily volatilise.

Method of application.

The carbon bi-sulphide should be evaporated in shallow plates. These should be placed on the top of the stack to be treated, as the gas formed is heavier than air, and consequently falls. The first fumigation is applied as soon as possible after digging. A proportion of eggs and pupae, as before stated, will survive the first treatment, making it necessary to apply a second fumigation. Two thorough treatments will destroy all forms of the moth.

Note.—As this is a highly inflammable and even explosive gas, there is great danger in bringing the chemical in proximity to fire, such as a lighted lantern, cigar, cigarette, or pipe. The chemical should be kept stored in an outhouse.

Fumigatory.

Every progressive grower should provide himself with fumigating facilities. A fumigator can be provided by making any room air-tight. A cheap method of constructing one is by building a strong framework and lining this with tough canvas, whitewashed with a strong whitewash and covered with a sized paper.

Take the cubic measurements of the room (length, breadth, and height), say 10 feet x 10 feet x 10 feet = 1,000 cubic feet of space, which is sufficient room in which to fumigate 120 to 150 bags of potatoes, and requires 2 lbs. of carbon bi-sulphide for a period of 48 hours.

Storage.

All the foregoing will be nullified unless the potatoes after fumigation are stored under moth-proof conditions. The treatment specified does not give immunity from further attack by moth if exposed.

A moth-proof room may be constructed by lining any building with sound strong hessian, giving attention to doors, windows, ventilators, and chimneys, but preferably a specially built store should be erected, properly fly-wired.

If these precautions are carried out by all growers the initial expense would be amply repaid by the prevention of loss and enhanced value of goods and will avoid the condemnation of tubers as unfit for human consumption.

It is unfortunately no uncommon sight to see heaps of moth-infested tubers in gardens, the ground littered with small tubers, and volunteer potato plants growing in the same vicinity as the crop.

We have witnessed great carelessness in all potato-growing districts. Growers, whether large or small, must be made to realise that the potato moth is as great an economic pest to the potato grower as the fruit-fly is to the fruitgrower, and needs consistent fighting.

Nothing but the most drastic measures will suffice in dealing with this virile pest. Fortunately, by co-operative effort, farm sanitation, fumigation, and proper moth-proof storage this pest can be controlled.

Summary.

1. Select moth-free seed.
2. Avoid the use of moth-infested bags, etc.
3. Keep the ground thoroughly worked and tubers well covered.
4. Never grow two crops of potatoes on the same ground in succession.
5. Dust foliage in early morning with equal parts powder arsenate of lead and slaked lime.
6. First dusting applied when plants are from 6 to 8 inches high.
7. Second dusting 14 to 16 days after the first.
8. Third dusting. May be necessary just before flowering.
9. Air-slaked lime and powder arsenate of lead (equal parts) dusted over tubers in storage is useful.
10. Night traps capture many moths.
11. Dig potatoes during cool hours, and before tops become so dry as to drive the caterpillars down to the tubers.
12. Bag and sew immediately after digging and cart to suitable shady storage.
13. Never leave potatoes exposed overnight.
14. Never place the haulms in the mouths of bags.
15. All cull potatoes to be gathered and destroyed or fed to animals.
16. All potato tops should be destroyed immediately after digging, and the land ploughed.
17. Fumigate with carbon bi-sulphide.
18. Quantity bi-sulphide: 2 lbs. per 1,000 cubic feet of space.
19. Period of fumigation: 48 hours.
20. Number of fumigations necessary: two, never more than three.
21. First treatment as soon as bagged.

22. Second treatment (summer) 6 to 8 days later; (winter) 12 to 16 days later.
23. Carbon bi-sulphide is placed in shallow dishes on top of stack.
24. As it is a highly inflammable and explosive gas, keep all lights away when using and store in detached outhouse.
25. Tubers, if exposed after treatment, will become re-infested.
26. After fumigation keep stored in cool moth-proof building.
27. Every progressive grower should provide himself with suitable fumigation and storage rooms.
28. Complete farm sanitation and co-operative action are essential in the control of this destructive insect.

REFERENCE.

Atherton, D. O., Queensland Agricultural Journals, Vol. XLV., Parts 1, 2, 3 and 4 (1936).

AGRICULTURAL PROBLEMS

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and names of Advisers are as follows:—

Albany	A. C. Vaughan.
Bridgetown	A. Flintoff.
Bunbury	M. Cullity.
Denmark	V. L. Cardon.
Geraldton	G. L. Throssell (Government Buildings).
Gosnells	R. C. Owen.
Harvey	D. L. Breen (Fruit); C. Giles (Dairying).
Katanning	A. S. Wild
Kalamunda-Roleystone	W. H. Read, c/o. Department of Agriculture, Perth.
Manjimup	K. W. Simes.
Metropolitan, Gingin, Chittering ...	S. E. Bennett, c/o. Department of Agriculture, Perth.
Metropolitan to Spearwood ...	R. L. Cailes, c/o. Department of Agriculture, Perth.
Mundaring	V. Cahill.
Narrogin	H. R. Powell.
Northam	F. L. Shier.
Northcliffe	H. S. Rogers.
Vasse	T. M. Nelson.

FIELD EXPERIMENTS WITH WHEAT AND OATS.

AGRICULTURAL RESEARCH STATION, WONGAN HILLS.

I. THOMAS, Superintendent of Wheat Farming.
A. R. VENTON, Farm Manager.

The average yields obtained at the Station indicate that the past season was, on the whole, a satisfactory one. It was not, however, free from anxious periods. The late summer and autumn was particularly dry, and apart from a minor fall about the 20th of April, no rain of consequence fell until the opening winter rains. On the 9th of May 26 points were registered, and from the 22nd to 31st 67 points on five days. It was not until 3rd June, with a fall of just over one inch, that there was sufficient moisture to cause a general germination of the seed.

Seeding was delayed until 1st May in the hope of rain germinating weed seeds and allowing of their destruction by cultivation, but after that date planting was proceeded with as quickly as possible. In view of the dry seeding it was fortunate that weed growth was not so pronounced as might have been expected.

Satisfactory rains occurred during June, July, and August for a total of 629 points. With the exception of 16 points on 13th September, no useful rain was recorded during that month until 30th when 63 points were registered, with a further 37 points on the following day. This dry period had visibly affected the crops, and these last falls improved them considerably. No further useful rain was received by the crops, but they matured apparently normally.

The rainfall recorded at the Station during 1936, together with the monthly averages for the 10 years 1926-35, is given in the following table:—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
1936				21	102	265	112	252	94	53	878	16	64	1,081
1926-35 ...	36	42	89	94	162	242	290	210	93	88	1,090	27	34	1,409

The land on which the experiments were conducted was typical smokebush and tussocky type of sand plain.

The land was ploughed with a disc cultivating plough in July and August, and cultivated with a springtyne implement in September and October. A similar cultivation followed by a harrowing was given prior to planting.

The results of the field experiments conducted during 1936 are tabulated below:—

RATE OF SEEDING EXPERIMENT—WHEAT.

To determine the most economical rate for planting a mid-season free-stooling variety.

Planted on 27th May, 1936. Germinated on 12th June, 1936. Superphosphate 120lbs. per acre.
Variety—Nabawa.

Rate of Seed. per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1936.	Percentage Yields, 1936.	Average Yields per acre, 12 years.	Percentage Yields, 12 years.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
60 lbs. ...	21 52	21 12	21 36	21 28	19 4	21 2	101	17 14	102
45 lbs. ...	21 36	20 56	21 20	21 20	18 48	20 48	100	16 51	100
90 lbs. ...	22 8	21 44	21 36	21 28	18 56	21 10	102	17 18	103

To determine the most economical rate for planting an early sparse-stooling variety.

Planted on 27th May, 1936. Germinated on 12th June, 1936. Superphosphate—120lbs. per acre. Variety—S.H.J.

Rate of Seed. per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1936.	Percentage Yields, 1936.	Average Yields per acre, 12 years.	Percentage Yields, 12 years.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
60 lbs. ...	17 4	17 52	18 32	19 28	18 8	18 13	103	14 27	103
45 lbs. ...	17 20	17 52	18 0	18 32	16 56	17 44	100	14 2	100
90 lbs. ...	17 44	18 16	18 48	19 28	17 52	18 26	104	14 46	105

The results are similar to those of previous years, and indicate that there is no advantage to be gained by increasing the rate of seeding above 45 lbs. per acre.

TIME OF PLANTING EXPERIMENT.

To determine the most suitable month to plant a mid-season maturing variety.

Variety—Nabawa. Superphosphate—120 lbs. per acre. Seed—45 lbs. per acre.

Time of Planting.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1936.	Percentage Yields, 1936.	Average Yields per acre.	Percentage Yields
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
April	12 0	12 32	12 32	11 28	12 0	12 6	99	16 8	99
May	11 28	13 52	12 48	10 40	12 16	12 13	100	16 18	100
June	14 24	17 36	15 44	16 0	16 32	16 3	131	12 11	75

To determine the most suitable month to plant an early maturing variety.

Superphosphate 120 lbs. per acre. Variety—Gluyas Early. Seed—45 lbs. per acre.

Time of Planting.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1936.	Percentage Yields, 1936.	Average Yields per acre, 1928–36.	Percentage Yields, 1928–36.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Mid-May ...	11 36	14 32	15 20	15 52	14 56	14 27	100	15 37	100
Mid-June ...	17 36	19 52	17 36	18 40	18 8	18 22	127	12 37	81
Mid-July ...	15 52	15 4	16 40	16 0	14 0	15 31	108	8 54	57

The results for last season are not in agreement with the average results over the past nine years, which forcibly demonstrate the inadvisability of prolonging the seeding into the middle of June, when conditions are suitable for earlier planting. Last season germination of the May-sown plots did not take place until 12th June, and weeds were not controlled, whereas, although the season opened very late, the June-sown plots had the weeds destroyed on them before planting. These results for last year indicate the necessity for satisfactory weed control before planting.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

To determine the most profitable amount of superphosphate to apply to the wheat crop.

Section 1.—Plots receiving rates of 150, 225, and 300 lbs. super. per acre.

Planted on 5th June, 1936. Seed—45lbs. per acre. Germinated on 15th June, 1936. Variety—Nabawa.

Rate of Application of Superphosphate per acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre, 1929–36.	Percentage Yields, 1929–36.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
150lbs.	20 8	20 0	20 24	21 12	21 28	20 38	100	20 18	103
300lbs.	21 44	20 48	22 0	21 52	22 40	21 49	106	19 47	100
225lbs.	21 12	20 48	21 52	21 52	22 40	21 41	105	20 21	103

Section 2.—Plots receiving rates of nil, 75, and 150 lbs. super. per acre.

Planted on 5th June, 1936. Seed—45lbs. per acre. Variety—Nabawa. Germinated on 15th June, 1936.

Rate of Application of Superphosphate per acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre, 1929–36.	Percentage Yields, 1929–36.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
75lbs.	18 56	19 52	19 52	20 0	20 8	19 46	82	15 10	79
Nil	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	2 45	14
150lbs.	23 44	24 8	24 8	23 52	24 8	24 0	100	19 10	100

This year's results confirm those of previous years, and show that to this class of country rates of superphosphate in excess of 75 lbs. per acre can be profitably applied. At present prices an application of 120 lbs. is warranted.

POTASH-NITROGEN EXPERIMENT.

To determine the effect upon the wheat crop of (a) a nitrogenous fertiliser; (b) a nitrogenous, plus a potassic fertiliser.

Planted on 5th June, 1936. Seed—45lbs. per acre. Variety—Nabawa. Germinated on 15th June, 1936.

Rate of Application of Fertiliser per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre, 1932–36.	Percentage Yields, 1932–36.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
112lbs. Sulphate of Ammonia; 120lbs. Superphosphate	22 8	22 16	21 36	22 56	21 36	22 6	110	24 16	119
120lbs. Superphosphate	20 0	20 8	20 40	19 28	19 52	20 2	100	20 28	100
112lbs. Sulphate of Ammonia; 56lbs. Sulphate of Potash; 120lbs. Superphosphate	21 52	22 24	22 48	22 0	23 12	22 27	112	24 43	121

Both this year's results and the average yields for the five years the experiment has been conducted, show that this class of soil is deficient in available nitrogen. By the application, in addition to superphosphate, of 1 cwt. of sulphate of ammonia, the average increase in yield has been approximately 4 bushels per acre. This means that with the wheat price in the vicinity of 4s. or more per bushel, the practice of applying 1 cwt. of sulphate of ammonia per acre over a period of years would be an economical one. It is, however, suggested that a more economical farming practice would be, where possible, the growing of leguminous fodder plants, such as lupins, clovers, etc., which would, in addition to increasing the amount of available nitrogen in the soil, also enable increased stock to be carried.

The addition of a potassic fertiliser in addition to the sulphate of ammonia has not given any increased grain yields.

SEASONAL PLANTING EXPERIMENT.

To determine (a) the most suitable month to plant the late, mid-season, and early varieties of wheat, and (b) the most prolific of these types.

APRIL PLANTING.

Planted on 15th April, 1936. Superphosphate—120lbs. per acre. Seed—45lbs. per acre. Germinated on 12th June, 1936.

Variety.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Percentage Yields, 9 years.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
Yandilla King ...	12 8	14 48	13 4	15 44	14 16	14 0	96	102
Nabawa	14 24	13 36	13 44	15 44	15 44	14 38	100	100
Sutton	15 52	15 36	14 16	18 8	19 4	16 35	113	112*
Bencubbin	19 4	19 20	17 4	18 0	20 16	18 45	114	117†
Nabawa	15 52	16 32	15 36	17 4	17 4	16 25	100	100
Gluyas Early	15 52	17 12	14 16	18 0	17 20	16 32	100	95
Totadgin	15 12	15 28	14 24	15 12	16 32	15 22	107	96‡
Nabawa	14 0	15 12	15 52	13 20	13 44	14 26	100	100

* Six year average. † Seven year average. ‡ Five year average.

MAY PLANTING.

Planted on 15th and 16th May, 1936. Superphosphate—120lbs. per acre. Seed—45lbs. per acre. Germinated on 12th June, 1936.

Variety.	Computed Yields per Acre.					Average Yields per acre, 1936.	Percentage Yields, 1936.	Percentage Yields, 9 years.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
Yandilla King ...	16 0	16 48	17 4	18 48	18 48	17 30	99	92
Nabawa	16 32	17 20	17 44	18 40	17 52	17 38	100	100
Sutton	17 4	19 4	19 52	19 4	19 12	18 51	107	98‡
Bencubbin	19 28	21 20	22 56	22 8	23 4	21 47	125	113*
Nabawa	16 0	17 4	18 16	17 20	18 48	17 30	100	100
Carrabin	16 40	18 32	19 12	19 4	19 36	18 37	106	101
S.H.J.	13 28	16 24	17 28	17 36	17 28	16 29	97	91
Nabawa	16 32	18 16	18 0	16 48	15 36	17 2	100	100
Merredin	16 56	18 16	17 36	17 4	14 48	16 56	99	92†
Gluyas Early	17 52	18 56	18 8	18 32	12 32	17 12	108	96†
Nabawa	16 32	18 0	18 24	15 52	10 48	15 55	100	100
Totadgin	15 36	17 12	16 16	12 8	10 24	14 19	90	88‖
Geeralying	15 28	13 36	13 36	15 28	12 0	14 2	91	87
Nabawa	15 12	15 20	16 0	16 56	14 0	15 30	100	100
Noongaar	...	17 12	16 32	16 48	12 48	15 50	102	76

* Seven year average. † Eight year average. ‡ Six year average. ‖ Five year average.

JUNE PLANTING.

Planted on 15th and 16th June, 1936. Superphosphate—120lbs. per acre. Seed—45lbs. per acre. Germinated on 25th June, 1936.

Variety.	Computed Yields per Acre.					Average Yields per acre, 1936.	Percentage Yields, 1936.	Percentage Yields, 9 years.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
Geeralying	8 48	6 40	8 8	9 4	12 8	8 58	74	88*
Nabawa	10 56	10 48	12 8	13 4	13 20	12 3	100	100
Bencubbin	10 24	11 44	12 56	12 32	16 32	12 50	106	105†
Carrabin	9 44	12 8	11 4	11 36	14 16	11 46	90	96
Nabawa	10 48	12 48	12 56	12 32	16 8	13 2	100	100
S.H.J.	9 28	11 4	11 4	12 0	13 44	11 28	88	99
Gluyas Early	10 32	10 40	10 8	13 36	15 36	12 6	88	90
Nabawa	12 8	11 36	12 8	16 0	16 40	13 42	100	100
Totadgin	8 32	8 48	9 4	12 16	13 20	10 24	76	83‡
Merredin	7 20	11 36	10 48	14 48	16 48	12 16	92	93*
Nabawa	8 0	12 24	12 48	15 36	17 20	13 14	100	100
Noongaar	6 24	10 0	10 0	13 20	17 36	11 28	86	92

* 8 year average. † 7 year average. ‡ 5 year average.

In the April-sown plots the late maturing variety "Sutton" and the mid-season variety "Bencubbin" have shown to advantage, not only in the results for this year but also in the average results over a number of years.

The variety "Bencubbin" was outstanding, also in the May and June-sown sections. Although it is a mid-season maturing variety, it is so drought-resistant and it has such a capacity for high yield that even when planted in June it out-yields the earlier varieties.

The premium milling variety "Carrabin" again yielded well last season, and now its average is at least equal to the control variety "Nabawa" for yield.

In the June-planted sections the mid-season maturing varieties "Bencubbin" and "Nabawa" outyielded other varieties, although the average yield for the section was distinctly below that planted in May.

RATE OF SEEDING EXPERIMENT—OATS.

To determine the most economical rate for planting (a) a late maturing oat variety, and (b) an early maturing variety.

Planted on 26th May, 1936. Superphosphate—120lbs. per acre. Germinated on 12th June, 1936.
Variety—Algerian.

Rate of Application of Seed per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre, 1926–36.	Percentage Yields, 1926–36
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
45lbs.	12 16	12 0	12 32	13 8	13 8	12 29	105	15 30	107
30lbs.	11 0	11 32	12 24	12 16	13 0	12 6	100	14 31	100
60lbs.	12 32	13 8	13 8	12 24	13 24	13 5	108	16 9	110

Planted on 27th May, 1936. Superphosphate—120lbs. per acre. Germinated on 12th June, 1936.
Variety—Burt's Early.

Rate of Seed per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre, 1926–36.	Percentage Yields, 1926–36.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
45lbs.	22 8	22 8	21 24	24 0	24 0	22 32	110	17 4	103
30lbs.	20 24	19 16	19 24	22 8	21 8	20 24	100	16 20	100
60lbs.	22 32	23 24	25 8	25 16	24 32	24 14	118	17 9	106

For both the late maturing variety "Algerian" and the early maturing variety "Burt's Early" the results, both for this year and for a period of 11 years, indicate that no significant increase in yield is obtained by planting at a rate greater than 45 lbs. per acre.

OAT VARIETY TRIAL.

To determine the most prolific varieties of oats under the conditions obtaining

Planted on 29th May, 1936. Superphosphate—120lbs. per acre. Germinated on 12th June, 1936.
Seed 40lbs. per acre.

Variety.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Percentage Yields, 8 years.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
Laggan	18 24	19 24	18 32	18 32	15 8	18 9	94	111*
Burt's Early	20 24	21 16	19 32	18 16	16 0	19 8	100	100
Belar	19 24	17 8	16 0	17 24	11 0	16 11	85	89†
C92	16 0	16 32	18 16	19 24	12 0	16 22	96	98*
Burt's Early	17 24	19 8	18 24	17 8	14 0	17 13	100	100
Mulga	22 8	20 8	20 16	19 0	16 32	19 29	114	97
W1	17 0	18 16	16 16	14 32	9 0	15 5	98	128*
Burt's Early	17 24	17 8	17 24	14 24	9 32	15 14	100	100
Algerian	16 24	14 24	16 0	13 0	9 24	13 38	91	107
Guyra	13 32	15 0	17 8	12 0	‡	14 20	85	96
Burt's Early	16 8	18 16	17 24	15 16	‡	16 36	100	100

* 2 year average. † 4 year average. ‡ Cultivated in error.

This year the variety "Mulga" was outstanding. The late opening of the season did not suit the late variety "Algerian." While the new crossbred "W1" did not yield quite as well even as "Burt's Early," its average over two years still reads well, and the results of further trials will be awaited with interest.

NITROGEN EXPERIMENT—OATS.

To determine the effect of applying a nitrogenous fertiliser to an oat crop which has been planted on fallow.

Planted on 29th May, 1936. Seed—45lbs. per acre. Germinated on 12th June, 1936.
Variety—Algerian.

Rate of Application of Fertiliser per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1936.	Percentage Yields, 1936.	Average Yields per acre, 1935–36.	Percentage Yields, 1935–36.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
6lbs. Sulphate of Ammonia ; 120lbs. Superphosphate	24 32	24 0	25 24	26 16	26 16	25 18	105	20 12	108
120lbs. Superphosphate	22 0	23 24	25 8	24 32	26 0	24 13	100	18 32	100
112lbs. Sulphate of Ammonia ; 120lbs. Superphosphate	25 24	26 16	26 32	25 8	27 8	26 10	108	21 15	114

The returns for two seasons show that while increased yields are obtained by the application of sulphate of ammonia at the rate of 56 lbs. and 112 lbs. per acre these increases are not economically obtained.

FUNGICIDE EXPERIMENT—WHEAT AND OATS.

To determine the comparative effect of copper and mercury dusting compounds on the germination, growth, and yield of wheat and oat crops.

Planted on 5th June, 1936. Superphosphate—120lbs. per acre. Germinated on 15th June, 1936.
Variety—Totadgin. Seed—48lbs. per acre.

Pickled with—	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	*Average Yields per acre, 1936.	Percentage Yields, 1936.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
A Mercury Compound	21 44	22 48	22 24	21 28	22 0	22 5	99
No treatment	21 20	23 4	22 24	22 16	22 24	22 18	100
Copper Carbonate	22 48	22 32	22 16	22 0	21 36	22 14	100

* Five replications.

Planted on 6th June, 1936. Superphosphate—120lbs. per acre. Germinated on 16th June, 1936.
Variety—Mulga. Seed—40lbs. per acre.

Pickled with—	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	*Average Yields per acre, 1936.	Percentage Yields, 1936.
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
A Mercury Compound	23 32	25 16	24 32	25 24	†	24 36	96
No treatment	25 24	27 32	25 0	25 32	†	26 2	100
Copper Carbonate	26 16	25 32	25 32	26 32	†	26 8	101

* Four replications. †Discarded owing to an error.

This past season was the initial year of the experiment.

In both the wheat and oats section the plots were seeded with grain which had been treated with a mercury compound dust, and the untreated grain plots showed to advantage in the early stages over the plots the seed of which had been treated with copper carbonate. About a month to six weeks after germination, however, all plots appeared equal, and remained so until harvesting time. As the results show, there was no significant difference between any of the seed treatments.

These results are for one year only, and further results are necessary before definite conclusions may be drawn.

DISINFECTION OF TOBACCO SEED.

H. A. J. PITTMAN, B.A., B.Sc. Agr. (Hons.), Dip. Ed.,
Plant Pathologist.

In the early days of the establishment of the tobacco industry in Western Australia, and before the Downy Mildew disease (*Peronospora tabacina*, Adam) had become universally present in the tobacco-growing districts of the State, it was the practice of the Plant Pathology Branch of the Department of Agriculture to undertake the disinfection of tobacco seed in absolute alcohol for private growers for a prescribed fee. However, for various reasons, it has been found desirable for the Departmental disinfection of tobacco seed belonging to private growers to be discontinued.

This must not be taken to mean that disinfection of tobacco seed is no longer considered an important part of the procedure necessary for the raising of disease-free plants, but it is now considered that tobacco growers should undertake the disinfection of their own tobacco seed, just in the same way, for example, that wheat growers are themselves expected to see to the effective pickling of their seed wheat for the prevention of "Bunt" and other seed-borne diseases, or cauliflower growers are expected to disinfect their own seed for the prevention of "black rot" or "black leg," etc.

In connection with the matter of disinfection of tobacco seed, the following are three of the methods most commonly recommended:—

1. *Corrosive Sublimate* (*Bichloride of Mercury*).

The solution is made by dissolving one part of the poison in 1,000 parts by weight of water, that is at the rate of 1 ounce in 6¼ imperial gallons (or nine (9) grains in one pint). Full details for the preparation of this seed disinfectant will be found below.

The seed is placed in this solution in calico or similar bags and kept well stirred for five minutes. The bags of seed are then removed from the poison, allowed to drain for a second or two and then washed for about fifteen minutes in running water, or not less than six changes of rain water. The seed is then spread out and allowed to dry in the shade before being planted, or re-packeted in a new packet.

PREPARATION OF CORROSIVE SUBLIMATE FOR SEED DISINFECTION.

Stock Solutions Recommended.

Corrosive sublimate (mercuric chloride) is the chemical most commonly used for the disinfection of vegetable- and flower-garden seeds, the most frequently used formula being that known as "1 in 1,000." This means 1 part by weight of Corrosive Sublimate (Mercuric Chloride) to 1,000 parts by weight of water. In publications originating in the United States of America, the directions for making up this "1 in 1,000" strength, are to dissolve the Corrosive Sublimate at the rate of 1 ounce in 7½ gallons of water. In British countries, however, the gallon measure used is larger than that used in the U.S.A., so that *the correct formula where using the Imperial gallon as a measure of volume is at the rate of corrosive sublimate 1 ounce avoirdupois in 6¼ Imperial gallons of water.*

Where large quantities of Corrosive Sublimate solution are required, as in the disinfection of potato tubers or gladiolus corms, *the most convenient method of preparation is to make up a stock solution at the rate of one pound of finely-*

powdered sublimate in two gallons of hot water. The poison may be dissolved by carefully pouring the hot water over it in the bottom of a wooden, earthenware, glass or enamelled vessel. After cooling, the solution should be stored in a tightly-stoppered, clearly-labelled, glass or earthenware jar, etc., under lock and key, till required. Metal containers must never be used for Corrosive Sublimate solutions, as they are corroded by the disinfectant. The chemical only dissolves very slowly in cold water, so that hot water should be used whenever possible in making up the stock solutions.

TABLE I.

DILUTION TABLE FOR MAKING 1 IN 1,000 CORROSIVE SUBLIMATE SOLUTION, USING A STOCK SOLUTION OF ONE LB. CORROSIVE SUBLIMATE IN TWO GALLONS OF WATER (OR HALF LB. IN ONE GALLON).

Stock Solution. Take amount indicated below.	Amount of dissolved sublimate in quantity of stock solution taken.	Dilute with clean cold water in wooden, glass, cement or earthenware container to final volume indicated below.
(a) ¼ pint	¼ ounce	1 gallon 4½ pints
(b) ½ „	½ „	3 gallons 1 pint
(c) ¾ „	¾ „	4 „ 5½ pints
(d) 1 „	1 „	6 „ 2 „
(e) 1 quart	2 ounces	12 „ 4 „
(f) ½ gallon	4 „	25 „
(g) 1 „	8 „	50 „
(h) 2 gallons	1 lb.	100 „

In cases where it is anticipated that only very little of the disinfectant will be required, as in the case of tobacco seed, a more convenient stock solution may be prepared by dissolving ½ *ounce* of Sublimate in *1 quart* of hot water (*or 2 ounces in one gallon*) by the same method as indicated above. For use this second stock solution is diluted as follows:—

TABLE II.

DILUTION TABLE FOR MAKING 1 IN 1,000 CORROSIVE SUBLIMATE, USING A STOCK SOLUTION OF ONE HALF OUNCE (½oz.) IN ONE QUART OF WATER (OR TWO OUNCES IN ONE GALLON).

Stock Solution. Take amount indicated below.	Amount of dissolved sublimate in quantity of stock solution taken.	Dilute with clean, cold water in wooden, glass, cement or earthenware container to final volume indicated below.
(a) ¼ pint	1/16th ounce	3¼ pints
(b) ½ „	1/8th „	6¼ „
(c) ¾ „	3/16ths „	1 gallon 1¾ pints
(d) 1 „	¼ „	1 „ 4½ „
(e) 1½ pints	3/8ths „	2 gallons 2¾ „
(f) 1 quart	½ „	3 „ 1 „
(g) ½ gallon	1 „	6 „ 2 „
(h) 1 „	2 ounces	12½ „

The strengths of all stock solutions should be written on the labels as soon as the solutions are prepared, and it would be just as well also to include a copy of the appropriate dilution table on the same or a separate label on the container.

Mercuric Chloride (Corrosive Sublimate) is deadly poisonous to human, animal or plant life. In addition, it is colourless, odourless, and comparatively tasteless, and may easily be mistaken in solution for pure water. It should therefore, be used with great care and kept out of the reach of children or farm stock. When finished with, the solution should be poured into a hole in the ground, and the hole be immediately filled in or covered over. In case of mercuric chloride poisoning give whites and yolks of eggs mixed with milk. In emergency ordinary flour paste may be used. Then give a mustard emetic to induce vomiting and send immediately for medical assistance.

METHOD OF USING THE DILUTED CORROSIVE SUBLIMATE FOR DISINFECTING SEEDS.

The seeds are best immersed in the dilute Corrosive Sublimate in a calico bag or muslin bag of such a fineness of weave that the seeds being disinfected will not fall through the meshes of the material. The bag should be kept constantly agitated in the solution so as to remove air bubbles, which otherwise tend to prevent intimate contact between the solution and portions of the seed coats. The capacity of the bag should be so great in proportion to the volume of the seeds being treated that they will be very free to move about inside the bag during the treatment. At the end of the time specified in the text for the particular kind of seed being treated, remove the bag, with its contained seeds, from the solution, allow to drain for a minute or two, and then immerse in clean running water for 15 minutes, before tipping out the seeds in a clean shady place to dry before re-packeting or sowing. In re-packeting the seeds, use a brand new packet, the old one having in the meantime been destroyed by fire, or in some similar manner, and the hands having been thoroughly washed with disinfectant soap and water before handling the seeds again.

2. *Silver Nitrate.*

Dissolve nine (9) grains of silver nitrate in one (1) pint of rain water or distilled water. (No other water is satisfactory.) This gives a "1 in 1,000" solution. Place the seed in this solution in calico bags and keep it well stirred for 15 minutes, then wash and dry as above.

3. *Absolute Alcohol.*

This is the method which is used in our own laboratory. The seed is dipped in calico bags in Absolute Alcohol and kept well stirred so as to remove air bubbles for five minutes (no longer). The seed is then removed from the Absolute Alcohol, allowed to drain for a few seconds and then spread out on sheets of clean, dry, unused blotting paper. The seed is stirred continually by hand or with a smooth stick and is transferred from time to time to a new piece of blotting paper as soon as the piece being used becomes saturated with alcohol. This process should be continued for about half an hour or so, by which time it will be found that the seed will be completely dry.

The seed should then be enclosed in a new, disease-free calico bag and put aside until required for use. It is advisable that after the alcohol treatment, the seed should not again be stored in a glass container until all traces of the alcohol fumes have completely disappeared. When treating the seed by this method, just sufficient alcohol should be used to completely cover the seed. It usually takes about 1 lb. of Absolute Alcohol to disinfect 1 lb. of tobacco seed satisfactorily. Not more than 1 lb. of tobacco seed should be treated in Absolute Alcohol at the one time, and it will be found very much more satisfactory, until some experience has been gained, to treat not more than 1-2 ounces at the one time.

Solutions of Corrosive Sublimate or of Silver Nitrate made up to the strengths indicated above, could be obtained from any pharmaceutical chemist from whom also the Absolute Alcohol could be obtained.

The Absolute Alcohol method will be found considerably more expensive than either of the other two treatments, although even in this case the cost per acre of tobacco grown is really infinitesimal. It has the advantage from a laboratory point of view that the seed dries very quickly, and so is soon out of the way.

No more than one of the above alternative treatments should be used on any one parcel of seed.

HAND LEVER BORING PLANT.

A. R. C. CLIFTON,
Officer-in-Charge of Irrigation.

While the percentage of failures in boring for water is high, especially in the dry areas, where other supplies are not procurable there is still no other method of prospecting for water available for the individual.

For deep boring the auger and rods are used, but for shallow depths, up to say 100 feet, the sinker bar and rope known as the "percussion method" is the simplest system and may be operated by two men, whereas the auger and rods require a minimum of three men.

The percussion method is operated by a boring tool suspended by a wire rope which is worked up and down by a spring pole or a lever. The accompanying drawings supplied by the Public Works Department show the details of a hand lever boring plant which requires the minimum equipment for boring for underground water.

Briefly, the plant consists of a sinker bar with chisel attached and a sludge or sand pump. These are rigged by means of a tripod of three poles of bush timber with a bolt through the top to which is slung a double pulley; one sheave for the boring tool and the other for the sand pump ropes, respectively, to work through from a large and small winch at the foot of the tripod. On one leg of the tripod a lever is provided and in operating the plant the boring tool is raised and let fall by alternately pulling down and letting go this lever, the short end of which is attached to the rope carrying the sinker bar. This repeated operation enables the boring tool to pound its way through the earth, the twisting and untwisting of the rope preventing the boring tool from always striking in the same place. A simple grip is provided at the short end of the lever which enables a fresh bight to be taken on the rope as the depth of the hole increases.

Instead of the lever a spring pole may be used. This is 25ft. long, the butt end being let into a notch cut in a tree 10 feet above the ground, or if no tree is available, the butt end is attached to a vertical post secured to a bed log buried in the ground. A forked post or trestle is provided 7 feet from the butt end for the pole to rest on so as to throw the working end higher than the butt. A short rope with a cross piece of wood to form a handle is attached near the working end.

The pole is pulled down by means of the handle and the drill rope attached in the same manner as shown in the drawing for the lever, the pole is then let go and the back spring lifts the boring tool, the movement being kept up by pulling down with little exertion and again releasing without letting go the handle.

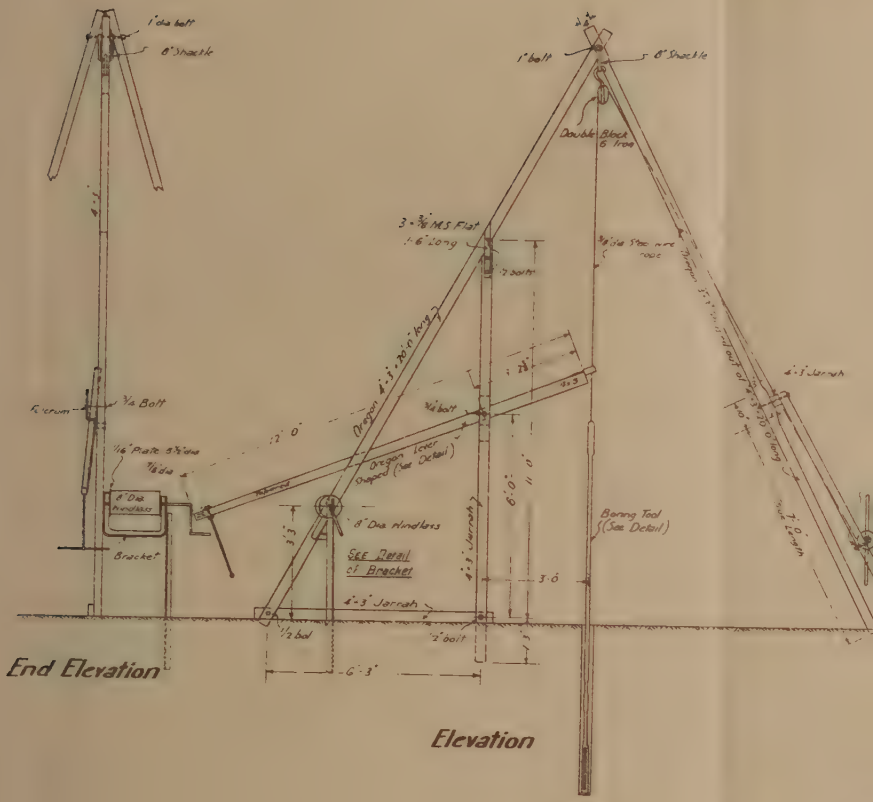
Whilst in operation, bits require constant watching and fresh tools substituted when the sides are worn. Otherwise when a new chisel of the proper size is introduced it will not pass down to the bottom of the hole and unnecessary delay is occasioned in enlarging it. Chisels should be at least ¼in. larger than the diameter of the sand pump, otherwise the latter will not follow through.

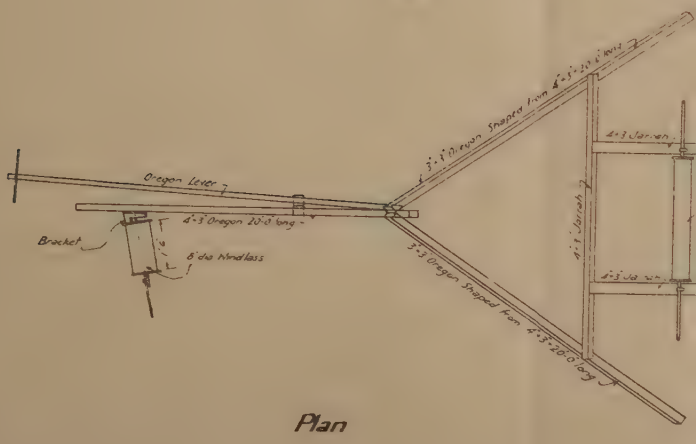
The sand pump is used to bring up the loose debris from the bottom of the hole. When the country is dry sufficient water is introduced into the bore hole—after the earth has been pounded up—to form a slurry capable of being picked up by the sand pump. If hard solid rock is encountered, the hole should be abandoned and a fresh site selected elsewhere.

Casing, which should not be driven but worked down the bore by means of a turning motion, is necessary if dry or wet sand is met and should follow the boring down.

Casing is not used, however, until necessary, and frequently a test hole can be put down without it. When a satisfactory supply of water is located, either a larger bore is put down and cased or, if found at a shallow depth, a well may be the best means of obtaining the desired supply, according to the conditions.

A
Borin
Tripod for H



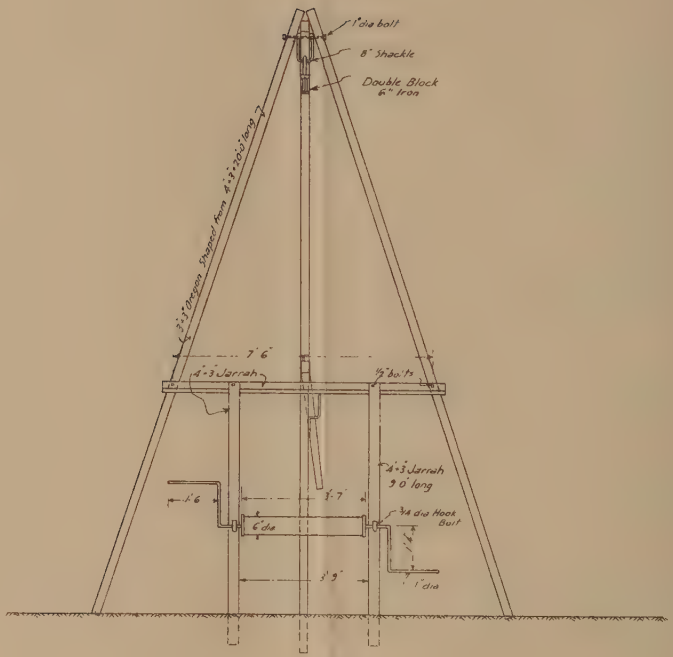


Plan

NO
TRIP

W.S.
Plants
Boring Plant

Drawing No 1.



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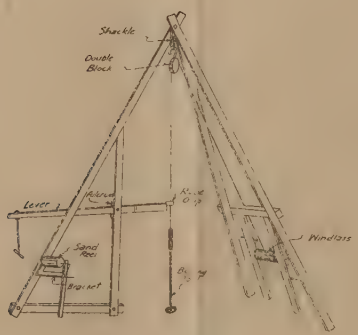
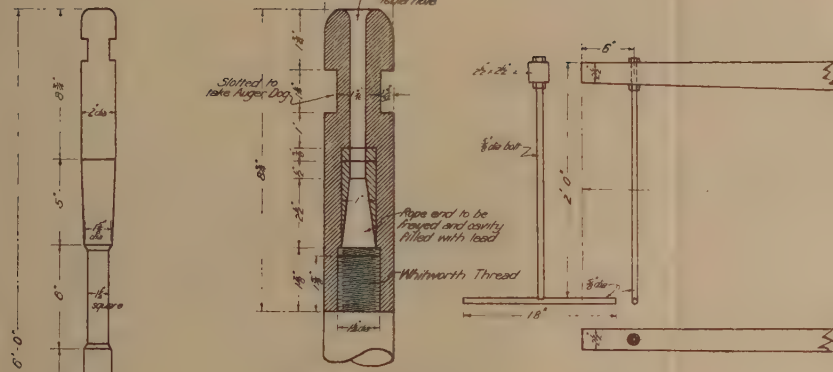


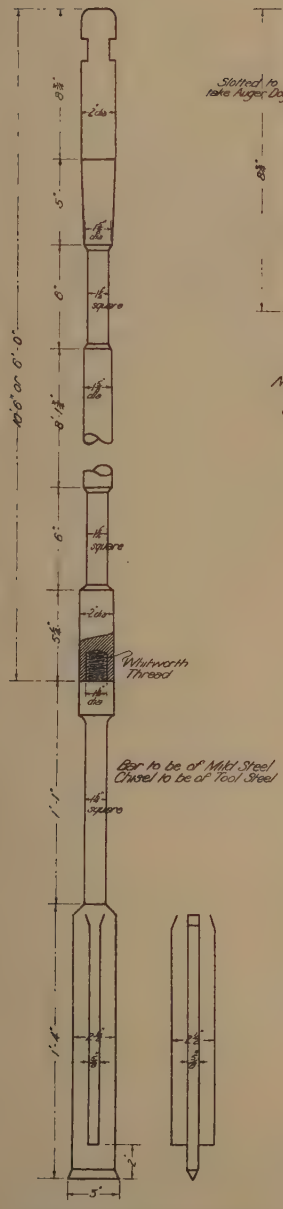
Hand Boring Plant

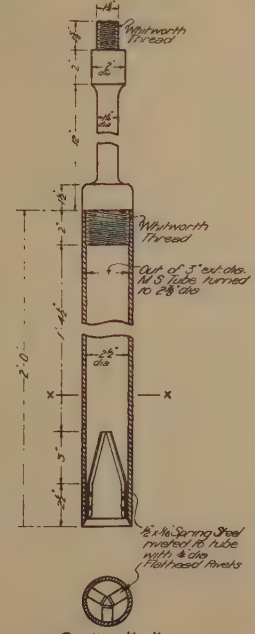
Chief Engineer for Water Supply

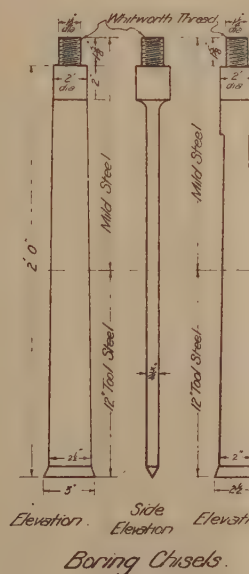
4.8.1938 File 425/38
COPY OF P.W.D. W.A. 25811

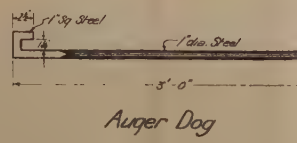
A.A.W.S.
Hand Lever Boring Details.



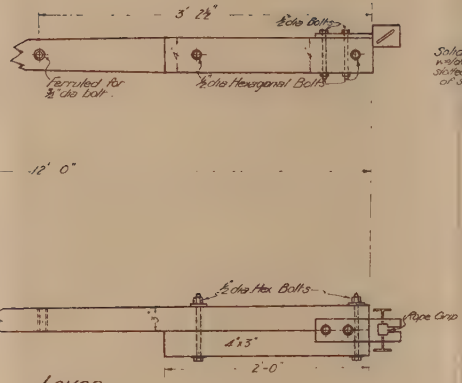




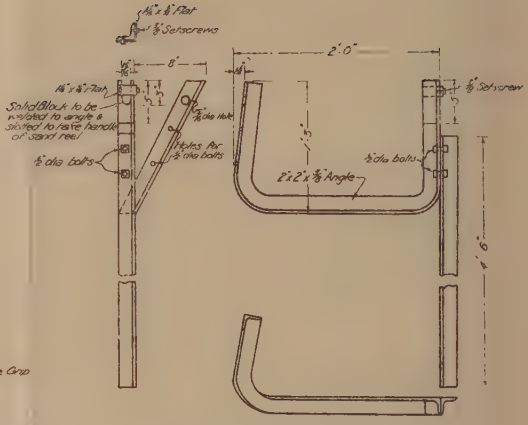




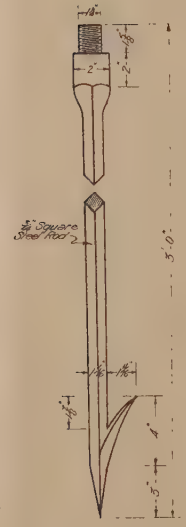
Plant.



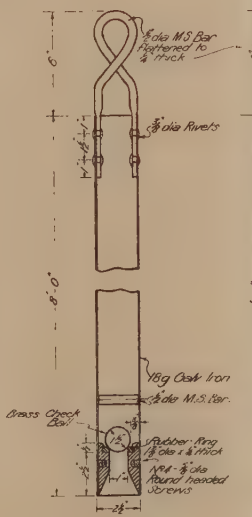
Lever.



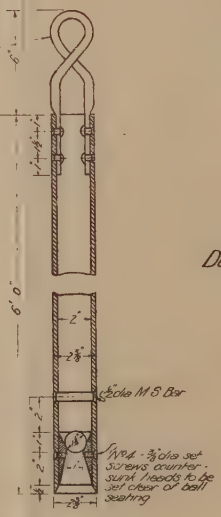
Bracket for Sand Reel.



Rope Hook.



Test Pump.



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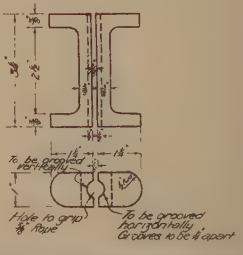
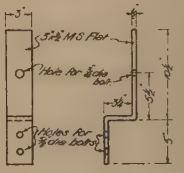
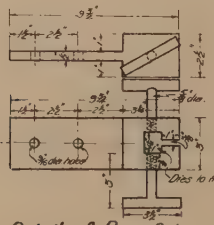


Detail of Dies for Rope Clip.



Lever Fulcrum.



Detail of Rope Grip.

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